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(See page 38)

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AMERICAN JOURNAL OF OPTOMETRY
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THE BASIS FOR FAILURE ON COLOR VISION TESTS*

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I. INTRODUCTION

This paper will present a brief summary of the currently known facts of abnormal color vision, with the aim of pointing out why individuals fail polychromatic (pseudo-isochromatic) screening tests and why improvements in performance on this type of test are not satisfactory evidence of improvement in fundamental color sensitivity or in the ability to make everyday color discriminations. [1, 3, 4, 5, 22] It will be possible to make suggestions as to why some individuals who originally fail a color vision screening test may be able to learn to pass it.

No new or original information will be presented. The writer has relied particularly on the work of Judd, [17] of Wright, [32] and of Fry. [8, 9, 30]

Although the descriptions of so-called color blindness to be found in even the most serious textbooks of physiology and psychology may be confusing, it is possible to define quite clearly the major types of abnormal color vision which have been found occurring with a statistically determinable frequency. Perhaps the main function of this paper will be to place information about these types of vision in the optometric literature, and to call attention to the original sources and recent summaries. This paper may also provide a background for the recent publication by Volk and Fry[30] which has presented original data and an interpretation of failure on the Ishihara test.

II. CLASSIFICATION OF TYPES OF COLOR VISION DEFICIENCY

In 1881, Lord Rayleigh, the English scientist, described a simple instrument which permitted a mixture of two narrow regions of the

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visible spectrum to be compared to a third region[27]. Rayleigh's original interest lay in investigating color mixtures as seen by the normal eye. Nevertheless, the results he obtained were more important for understanding abnormal color vision, because the " . . . first trials of this instrument . . . revealed an interesting peculiarity of colour vision, quite distinct from colour blindness. The red and green mixture which to my eyes and to those of most people matches the perfectly homogeneous yellow of the line D, appeared to my three brothers-in-law hopelessly too red, . . . " [27, p. 65]. In all, five subjects were observed who required "only half as much red . . . to turn a given amount of green into yellow." Two other observers were found who, on the other hand, required about two and one-half times as much red as the normal. With this simple description Rayleigh established a new category of color vision, and at the same time set the pattern for what has come to be recognized as the simplest test which will differentiate the types currently found to occur with a statistically determinable frequency.

At that time, "color-blindness" meant a condition of dichromic vision, in which only two color mixture primaries were required to produce all possible variations of hue and saturation. Such individuals, it was recognized, could not discriminate the red from the green, and consequently for them either color, or any mixture of the two, would match the yellow.

Rayleigh's subjects, on the other hand, were like the normal individual in requiring three color mixture primaries. In consequence such abnormal color vision has been termed anomalous trichromatism.[20]

In 1897 Von Kries[19] proposed the non-theoretical terms protanopia and deuteranopia, i.e., the first and second types of color-blindness, to apply to the two types of dichromats who had previously been called, primarily on theoretical grounds, red blind and green blind. The "red blind" or protanopic individual is relatively insensitive to the longer wavelengths in the spectrum which appear red to the normal observer, i.e., this end of the spectrum is not as bright as for the normal. The "green blind" or deuteranopic individual is essentially normal in this respect. Then in 1908 Nagel[24] extended the non-theoretical designation to apply to the anomalous trichromats, calling those who required extra amounts of red, protanomalous, and those who required extra amounts of green, deuteranomalous.

An instrument which permits the adjustment of a red and green mixture to match a yellow is now referred to as an anomaloscope,[23] because of its use in discovering individuals with anomalous trichromatic

vision. The match is referred to as the "Rayleigh match," and the proportions of red and green equated to yellow as the "Rayleigh equation." If a ratio of red to green greater than the normal is required, protanomaly is indicated; if the ratio is less than normal, deuteranomaly is indicated. Dichromats can also be identified through their inability to choose one mixture in preference to another. Furthermore, if the instrument includes a means of measuring the brightness of the red in comparison to the green, the protanopic, red-insensitive, dichromat can be distinguished from the deuteranope.

By use of the anomaloscope, then, it is possible to segregate the four main types of color vision deficiency. Judd[17] has prepared a table based on a number of statistical surveys with the anomaloscope which shows the incidence in the population of various types of color blindness (Table I). The figures on the incidence of the third type of anomalous trichromatism (tritanomaly) and on the third and fourth types of dichromatism (tritanopia and tetartanopia) are not based on actual statistical determinations, but are estimates. These conditions have been found so infrequently and their characteristics so little studied as to warrant their omission from this discussion.

Considerable emphasis has been placed on the anomaloscope test, because in a sense it stands intermediate between the color plates so widely used for discovering "color-blindness," and careful laboratory determination of the exact characteristics of abnormal color vision. Recent work has emphasized that color vision test plates, commonly called pseudo-isochromatic, are at best rough screening tests which do not reliably distinguish the various types of defects, which may give variable results from one edition to another, and which must be administered under fixed conditions that are not usually attained.[7, 10, 11, 12, 13, 14, 15, 29, 30]

Designation by number of components	Non-theoretical designation (v. Kries)	Percentage of the population that have these visual systems Male		Female	
Anomalous trichromatism	Protanomaly	1.0		0.02	
	Deuteranomaly	4.9		0.38	
	Tritanomaly	0.0001		0.0000	
			5.9		0.40
Dichromatism	Protanopia	1.0		0.02	
	Deuteranopia	1.1		0.01	
	Tritanopia	0.0001		0.0000	
	Tetartanopia	0.0001		0.0000	
			2.1		0.03
Monochromatism	Total color-blindness	0.003		0.002	
Abnormal systems			8.0		0.43
Normal system			92.0		99.57

Table I. Incidence of various types of color vision. Prepared by Judd[17] primarily from results of anomaloscope tests.

On the other hand, laboratory tests begin to provide a complete and quantified description of color vision. However, these tests are difficult and tedious and require very specialized apparatus, with which it is possible to determine such color vision functions as the luminosity curve (distribution of luminance* in the spectrum), wavelength discrimination curve (minimum difference in wavelength necessary to produce a just discriminable difference in chroma), and color mixture curves (proportions of color mixture primaries required to match each wavelength in the spectrum). The results in the anomaloscope test depend on any abnormality of the luminosity or color mixture functions** and to this extent reflect the basic color vision functions.

It should also be pointed out that the anomaloscope does not require a knowledge of hue names or other color terminology. A color discrimination or a judgment of equality is required. The results will be the same independent of the observer's background with respect to color names.

III. DATA FOR THE DIFFERENT TYPES OF COLOR VISION

It is possible to gain some insight into the reasons why individuals with abnormal color vision fail the pseudo-isochromatic tests from a consideration of their performance on the anomaloscope. The inability of the dichromats to distinguish even pure spectral red from pure green accounts for a number of their failures on the color plates. It will be possible to make a somewhat more thorough analysis, however, after reviewing the data on various types of color sensitivity which are available for these individuals. As indicated above, the important types of data which are available come under the headings of

1. Luminosity distribution in the spectrum
2. Wavelength discrimination curves
3. Color mixture curves.

The following figures and discussion will permit a comparison of the response of the various types of color deficient eyes to that of the normal in color discrimination of this sort.

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*In this discussion the terms luminosity, luminance, and brightness have been used in accordance with the definitions included in the report of the colorimetry committee of the Optical Society of America (J. Opt. Soc. Amer., 1944, 34, 245-246). However, luminance in the case of defective color vision is defined in terms of the luminosity curve for the given type of deficiency, rather than on the basis of the standard luminosity curve.

**When the anomaloscope is used as suggested by Fry[30], the brightness and color mixture components of the match are determined separately. Furthermore an indication of the sensitivity to changes in color mixture (related to wavelength discrimination) is obtained.

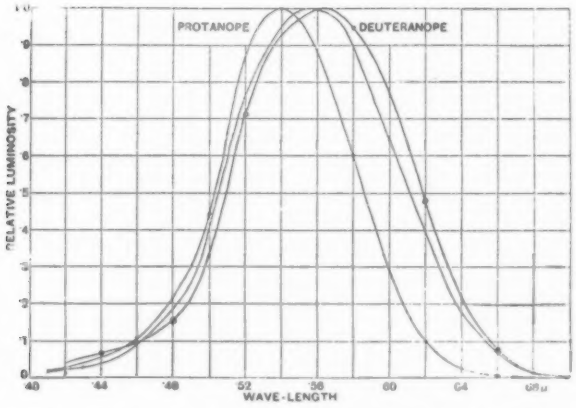

Figure 1. Mean luminosity curves for six protanopes and six deuteranopes compared to that of a normal subject.[26] These curves present, essentially, the distribution of luminance (brightness) in an equal energy spectrum. Of primary significance is the low luminosity of the long wavelength end of the spectrum for protanopes as compared to the normal and deuteranopes.

Color mixture data are available for those protanomals and deuteranomals with sufficient discrimination to make reliable color mixture settings.[21, 25, 32] As plotted, these curves are not notably different from the normal, if the insensitivity to color differences of the anomalous trichromat is taken into account. However, there is one very important difference, which does not appear in the curves, between the normal and the protanomal on the one hand, and the deuteranomal. The latter group used color mixture primaries in which the relative luminance of the green primary was approximately double that for the other two groups. In other words, if the color mixture curves were plotted in luminance units, the deuteranomals would be seen to use about double the amount of green required by the normal and protanomal. The

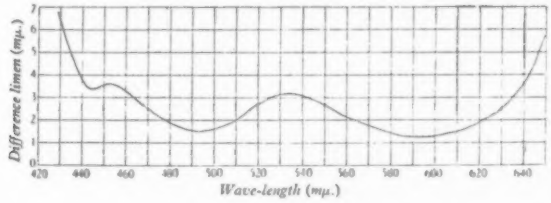

Figure 2. Mean wavelength discrimination curve for five normal observers[33]. This curve indicates the difference limen, or least perceptible change in wavelength, at each wavelength in the visible spectrum.

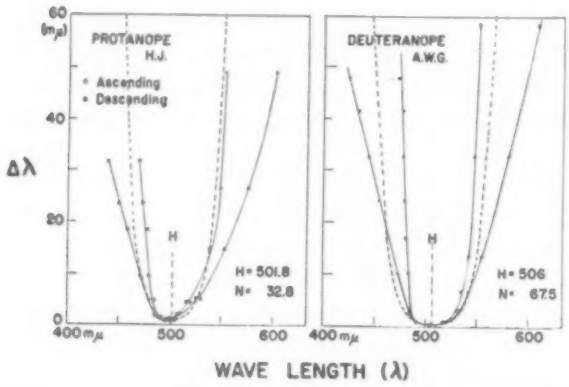

Figure 3. Wavelength discrimination curves for a protanope and a deuteranope. (From Fry's analysis[8] of Hecht's data[16].) The dotted curves and the constants H and N relate to the equation given by Fry. The solid curves indicate the difference limens ($\Delta\lambda$) at each wavelength. The lower branches indicate the threshold when the difference is toward the center of the spectrum. The upper branches indicate the threshold when the difference is taken toward the ends of the spectrum.

deuteranomal is truly "green-weak" in the sense that the green region of the spectrum, although having normal relative brightness, is deficient in chroma or color valence. On the other hand, a given brightness of red

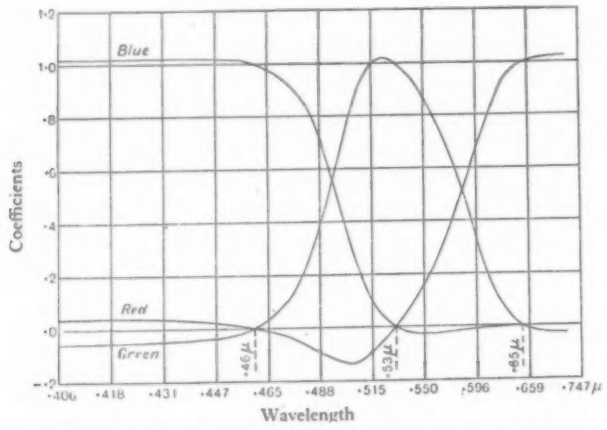

Figure 4. Color mixture data. Mean curves for ten normal trichromatic observers[31]. The three ordinate values at each wavelength indicate the proportions of three color mixture primaries (460 mμ, 530 mμ, and 650 mμ) required to match the given wavelength. The negative values indicate that the wavelength could not be matched directly in saturation and had to be desaturated with one of the primaries, and to the extent indicated by the negative value. The intensities of the color mixture primaries were measured in units which had the following mean relative luminances: red, 66.6; green, 100.0; and blue, 5.2.

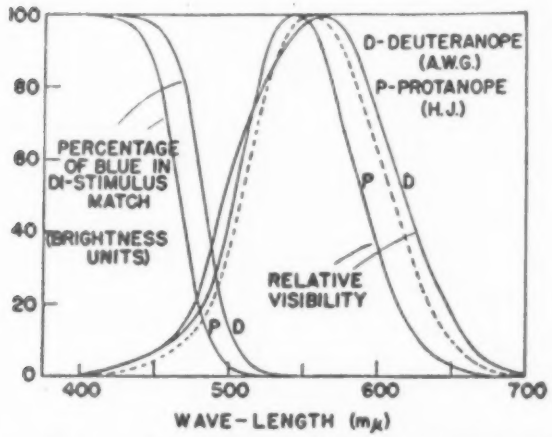

Figure 5. Color mixture and luminosity data for a protanope and a deuteranope. (From Fry's analysis[8] of Hecht's data[16].) The luminosity (visibility) data show the same relationship to the normal (dotted curve) as in Figure 1. The color mixture curves plot the percentage of blue (wavelength 458.7 $m\mu$) in a yellow-blue mixture required to match a given wavelength. For short wavelengths 100 per cent of blue is required, for medium and long wavelengths zero per cent of blue (100 per cent of yellow, wavelength 570.0 $m\mu$) is required.

for the protanomal is just as potent in color mixtures as a comparable brightness of red for the normal. The protanomal is not "red-weak" in the same sense as the deuteranomal is "green-weak," but only in the sense that the long wavelength end of the spectrum is lacking in brightness.

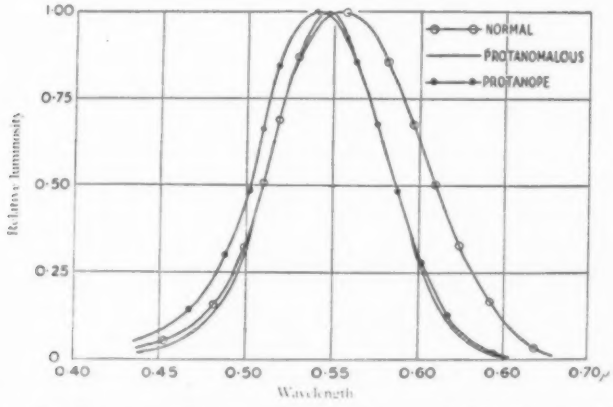

Figure 6. Luminosity curve for protanomals (mean of 11 observers)[21], compared to normal and to protanope. As with protanopes, the important characteristic is the low luminosity of longer wavelengths.

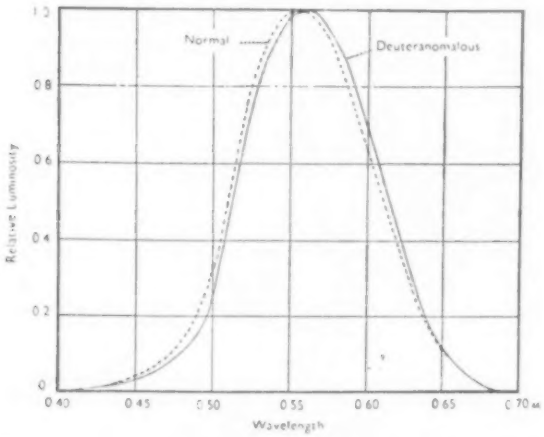

Figure 7. Luminosity curve for deuteranomals (mean of 5 observers)[32], compared to normal. As with deuteranopes, the curve falls well within the limits of variability of the normal[17].

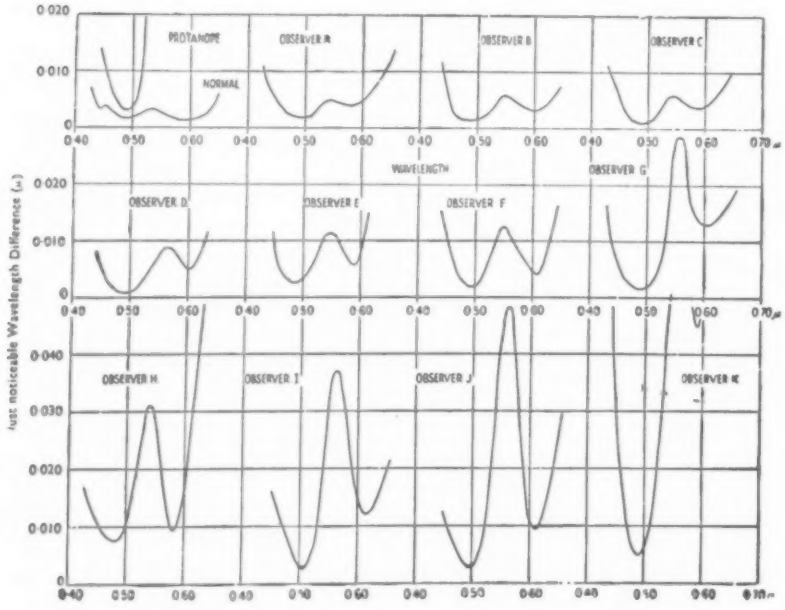

Figure 8. Wavelength discrimination for individual protanomals, compared to normal and to protanope. (Figure from reference[32], original data from reference[21].) Discrimination varies from nearly normal to nearly dichromatic. The primary loss in discrimination lies in the long wavelength region, with maximum loss in the region 530 to 580 $m\mu$, i.e., green to yellow.

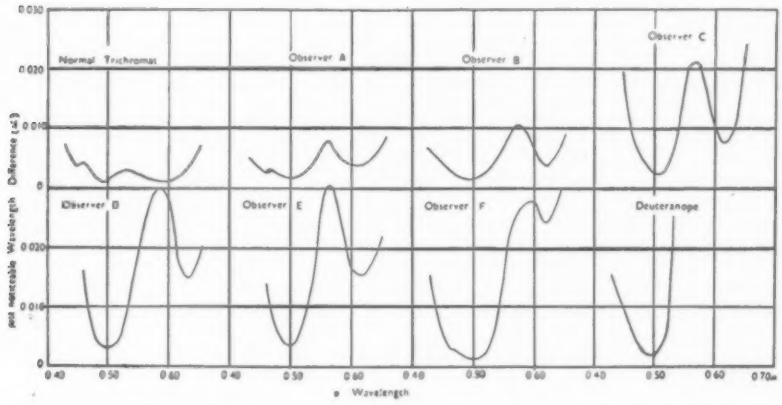

Figure 9. Wavelength discrimination for individual deuteranomals, compared to normal and to deuteranope. (Figure from reference[32], original data from reference[25].) Discrimination varies from nearly normal to nearly dichromatic. The primary loss in discrimination lies in the long wavelength region, with maximum loss in the region 530 to 600 m_{μ}, i.e., green to orange.

IV. ANALYSIS OF FAILURE ON COLOR VISION TEST PLATES

The 8-3 transformation pattern from the Ishihara test (plate 2 in the 7th edition, plate 5 in the American Optical Company compilation of plates) represents the types of color discrimination required on tests of this sort. The normal sees a predominantly red eight against a predominantly green background. The figure is actually made up of oranges and purplish-pinks, and the background of yellow-greens and blue-greens. The blue-green and pink dots are arranged to form a figure 3, which the color deficient individual usually sees. For him the blue-green and pink dots are not different, or at least look much alike, and so also with the orange and yellow-green dots.

For the dichromats a basis for the confusion between orange and yellow-green can be seen immediately in the anomaloscope data and in the wavelength discrimination and color mixture data. The basis for the confusion between blue-green and pink is less immediately apparent from the discrimination data. But it must be remembered that the purplish-pink used can be matched, for the dichromat, by a mixture of the long and short wavelength primaries, and such a mixture is seen as very desaturated, or nearly white. The blue-green is also close to the neutral or white point of the dichromat's spectrum, so together these form a figure of desaturated chromas against a more highly saturated background. Pitt[26] and Judd[17] have formulated these color confusions

of dichromats by plotting, on a standard color mixture diagram, the areas which, as derived from dichromatic color mixture data, will appear alike to these people. Figure 10 gives the hue names applied by normal individuals to the colors corresponding to various areas of the standard color mixture diagram[18], and Figure 11 gives the areas of confusion for protanopes and deuteranopes. These figures summarize in quantitative form the usual statements about color confusions and the description of the spectrum for these individuals. Pure reds, yellows, and part of the greens fall within one area, confirming the original classification of red-green blindness, or better, red-green confusion.

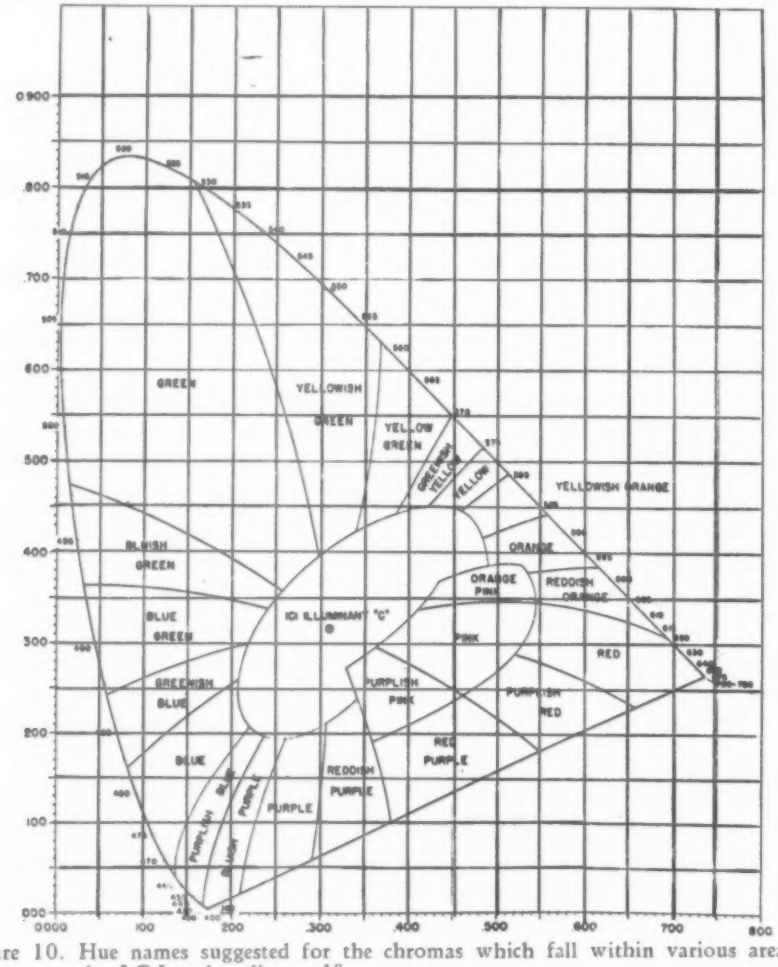

Figure 10. Hue names suggested for the chromas which fall within various areas of the I.C.I. color diagram[18].

Equally clear-cut confusions occur in the blue-purple portion of the diagram. The well-known presence of a neutral point in the spectrum, and one in the non-spectral purples, is show on the diagram, since all colors falling on the line through C (the white point for the normal) also appear white for the dichromat. As pointed out by Pitt, color-blindness tests are based, either knowingly or unknowingly, on such information.

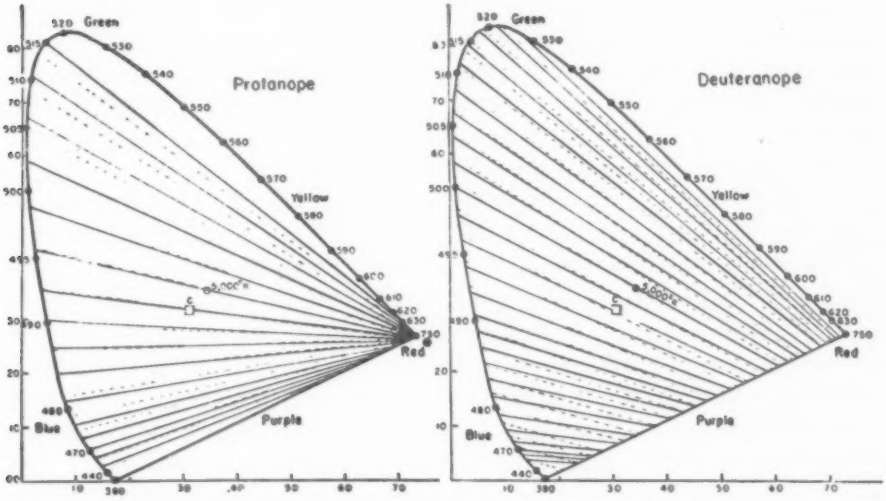

Figure 11. Areas on the I.C.I. color diagram which include chromas that are confused by protanopes and by deuteranopes[17]. The dotted lines are from the color mixture data of Pitt's subjects[26]. The solid lines are theoretical.

It is more difficult to detail the basis for failure of the anomalous trichromats. The reduced sensitivity for longer wavelengths exhibited by protanomalous individuals will contribute to the type of confusion which produces failure. Reducing the amount of red in the orange chromas will make them like the yellow-greens, and reducing the amount of red in the purplish-pinks will make them more like blue. This phenomenon makes it possible to produce failure in the normal if a red-free filter is used to view the charts. (This procedure was first suggested to the writer by G. A. Fry, and has been reported in references 1 and 30.) That the reduced sensitivity of the protanomals to longer wavelengths has an influence on their performance is suggested by the greater number of charts failed by this type of individual as compared to deuteranomals, as reported by Hardy, Rand & Rittler.[12]

Both types of anomalous trichromats show reduced wavelength

discrimination ability, ranging from nearly normal to nearly dichromatic. The reduction of wavelength difference sensitivity, particularly in the green to orange region, must of necessity be reflected in a decreased sensitivity to differences in color mixture, and thus will permit color confusions. The deuteranomal shows a loss in wavelength discrimination which extends farther into the long wavelength region than does that of the protanomal. This will contribute to confusions between orange and yellow-green, and works in the direction of equalizing the numbers of failures between the two groups of anomals, i.e., the protanomals are handicapped with respect both to luminosity and to wavelength discrimination, whereas the deuteranomals are handicapped only with respect to wavelength discrimination, but over a somewhat greater extent of the spectrum, on the average.

The relative insensitivity of the deuteranomalous eye to green, in color mixtures, means that the chromas which are made up of mixtures of red and green will be seen redder. This would work against the confusion of orange with yellow-green, and aids in counteracting the effects of poor wavelength discrimination in this region. This would also contribute to the better performance of deuteranomals mentioned above. This may be a factor in the relatively greater improvement shown by this group when the illumination of the charts is made redder, although the increased relative brightness of the redder dots is probably more important, especially in view of the slightly super normal luminosity coefficients in this region.

The basis for failure to make the distinction between purplish-pink and blue-green is more difficult to analyze from the data. In this connection it should be remembered that failure on the transformation type of chart does not necessarily involve inability to discriminate between pink and blue-green and between orange and yellow-green. It means simply that the pink is seen more like blue-green than like orange, which in turn looks more like yellow-green than like pink. Some individuals can name these four hues correctly, and still will associate them incorrectly in figure and background relationships so that they fail the test.

V. THE BASIS FOR LEARNING TO PASS POLYCHROMATIC CHARTS

If it is assumed that tests of color deficiency are properly administered, and precautions taken against rote learning, i.e., memorization of the correct answers, how is it possible for individuals who first fail the test to succeed in passing subsequently? That changes in color discrimination occur of an appreciable magnitude seems entirely unlikely.

As a matter of fact, data of the sort presented are obtained from highly practiced experimental subjects, and probably represent nearly the limit of improvement to be expected. No one would predict that the abnormal luminosity curves or wavelength discrimination curves would change sufficiently with practice to fall within normal limits.

We can note, however, that certain color deficient individuals are close to normal in some aspects of color vision, and further that even some dichromats pass a few of the plates to begin with. This leads to the conclusion that the numbers on the plates range around the borderline of visibility. It is not surprising then that many of the plates can be discriminated with a little practice. Once the number on a plate has been worked out on the basis of just barely discriminable cues, it is perceived as a figure on a background, and will appear more prominently than it did previously. We can admit the possibility of some individuals learning at least some of the plates on the basis of color differences which were not prominent enough to make the number stand out clearly at first. Furthermore this ability can apparently be transferred to similar test plates which have not been seen before. This does not imply any improvement in general color performance, and the subject's report of improvement requires objective verification which could be supplied only by some sort of independent test of discrimination.

There are other factors which will permit improvement on the test. Some individuals show improved ability to discriminate color plates in a restricted region of the visual field smaller than that subtended by the number in a color plate when it is at the recommended testing distance.[2, 30] The subject could learn to "scan" the plate with his area of better discrimination.

A number of imperfections in the test plates have been pointed out which might permit learning on the basis of secondary cues. Administration of the test under improper conditions of illumination may also contribute to improvement in some cases.[11, 12, 14]

The writer concludes that it is not necessary to suppose a general improvement in the ability to discriminate previously indiscriminable color differences, or in the ability to differentiate color differences which were just barely noticeable in order to account for improvement with practice on color vision tests of the sort discussed here.

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The Optical Society of America: Table I, Figs. 3, 5, 10 and 11.
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REFERENCES

1. Bridgman, C. S., and Hofstetter, H. W., "Improving" Color Vision, Optometric Weekly, 1943, 34, 471-473.
2. Chapanis, A., Spectral Saturation and Its Relation to Color-Vision Defects, J. Exp. Psychol., 1944, 34, 24-44.
3. Dunlap, D., Defective Color Vision and Its Remedy, J. Comp. Psych., 1945, 38, 69-85.
4. Dvorine, I., Improvement in Color Vision in Twenty Cases, Amer. J. Optom., Arch. Amer. Acad. Optom., 1946, 23, 302-321.
5. Elder, J. H., Effectiveness of Vitamin A in the Treatment of Defective Color Vision, Science, 1943, 97, 561-562.
6. Elder, J. H., Note on Dunlap's Remedy for Color Vision, Psych. Bulletin, 1946, 43, 77-79.
7. Farnsworth, D., and Kimble, P., Compilation of Research on Abridgment of the American Optical First Edition Pseudo-Isochromatic Plates, x-749 (Av-384-k) Color Vision Report No. 14, Medical Research Dept., U. S. Submarine Base, New London, 9 Dec. 1946.
8. Fry, Glenn A., A Quantitative Formulation of Color Mixture and Chroma Discrimination Data for Dichromats, J. Opt. Soc. Amer., 1944, 34, 159-166.
9. Fry, Glenn A., A Photo-Receptor Mechanism for the Modulation Theory of Color Vision, J. Opt. Soc. Amer., 1945, 35, 114-135.
10. Gallagher, J. R., Gallagher, C. O., and Sloane, A. E., A Critical Evaluation of Pseudo-Isochromatic Plates and Suggestions for Testing Color Vision, Yale J. Biol. and Med., 1942, 15, 79-98.
11. Hardy, LeG. H., Rand, G., and Rittler, M. C., Tests for the Detection and Analysis of Color-Blindness. I. The Ishihara Test: An Evaluation, J. Opt. Soc. Amer., 1945, 35, 268-275.
12. Hardy, LeG. H., Rand, G., and Rittler, M. C., Tests for the Detection and Analysis of Color-Blindness. II. The Ishihara Test: Comparison of Editions, J. Opt. Soc. Amer., 1945, 35, 350-356.
13. Hardy, LeG. H., Rand, G., and Rittler, M. C., Tests for the Detection and Analysis of Color-Blindness. III. The Rabkin Test: J. Opt. Soc. Amer., 1945, 35, 481-491.
14. Hardy, LeG. H., Rand, G., and Rittler, M. C., The Effect of Quality of Illumination on the Results of the Ishihara Test, J. Opt. Soc. Amer., 1946, 36, 86-94.
15. Hardy, LeG. H., Rand, G., and Rittler, M. C., A Screening Test for Red-Green Blindness, J. Opt. Soc. Amer., 1946, 36, 610-614.
16. Hecht, S., and Shlaer, S., The Color Vision of Dichromats. I. Wavelength Discrimination, Brightness Distribution, and Color Mixture, J. Gen. Physiol., 1936, 20, 57-93.
17. Judd, D. B., The Facts of Color Blindness, J. Opt. Soc. Amer., 1943, 33, 294-307.
18. Kelly, K. L., Color Designations for Lights, J. Opt. Soc. Amer., 1943, 33, 627-636.
19. von Kries, J., Ueber Farbensysteme, Zeitschr. f. Psychol. u. Physiol. d. Sinn., 1897, 13, 241-324.
20. Konig, A. and Dieterici, C., Die Grundempfindungen in normalen und anomalen Farbensystemen und ihre Intensitatsverteilung im Spectrum, Zeitschr. f. Psychol., 1893, 4, 241-347.
21. McKeon, W. M., and Wright, W. D., The Characteristics of Protanomalous Vision, Proc. Phys. Soc. (London), 1940, 52, 464-479.
22. Murray, E., Alleged Cures of Color Blindness, Amer. J. Psychol., 1945, 58, 253-262. (Reprinted in Optical Developments, 1946, 16, No. 4, White-Haines Opt. Co., Columbus, Ohio.)

23. Nagel, W. A., Zwei Apparate fur die augenartzliche Funktionsprufung. Adaptometer and kleines spektralphotometer (Anomaloskop). Zeit. f. Augenheilk., 1907, 17, 201-222.
24. Nagel, W. A., Zur Nomenklatur des Farbensinnsstorungen. Z. f. Psych. u. Physiol. d. Sinnesorg. IIAbt., Zeitschr. f. Sinnesphysiol., 1908, 42, 65-68.
25. Nelson, J. H., Anomalous Trichromatism and Its Relation to Normal Trichromatism. Phys. Soc. London, 1938, 50, 661-702.
26. Pitt, F. H. G., Characteristics of Dichromatic Vision. Medical Research Council, Report of the Committee on the Physiology of Vision: XIV. Special Report Series, No. 200 (London, 1935).
27. Rayleigh (Lord), Experiments on Colour. Nature, 1881, 25, 64-66.
28. Sloan, L. L., The Eastman Color-Temperature Meter Used as an Anomaloscope, J. Opt. Soc. Amer., 1944, 34, 618-620.
29. Sloan, L. L., An Improved Screening Test for Red-Green Color Deficiency Composed of Available Pseudo-Isochromatic Plates, J. Opt. Soc. Amer., 1945, 35, 761-766.
30. Volk, D. and Fry, G. A., Effect of Quality of Illumination and Distance of Observation upon Performance in the Ishihara Test. Amer. J. Optom., Arch. Amer. Acad. Optom., 1947, 24, 99-122.
31. Wright, W. D., A Redetermination of the Trichromatic Coefficients of the Spectral Colors. Trans. Opt. Soc. London, 1928-29, 30, 141-164.
32. Wright, W. D., Researches on Normal and Defective Color Vision. C. V. Mosby Co., St. Louis, 1947.
33. Wright, W. D., and Pitt, F. H. G., Hue Discrimination in Normal Color Vision. Proc. Phys. Soc. London, 1934, 46, 459-468.

DISCUSSION

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Dr. Bridgman's paper is a distinct addition to optometric literature. During recent years there has been a tendency for somewhat unscientific and inaccurate statements regarding "cures" of color vision. Much of this has been caused by faulty testing of color vision. Too much reliance has been placed on color vision tests that, while perfectly reliable when used as originally intended, are absolutely unreliable when misused or used for purposes for which the tests were not designed. A better understanding of color vision will eliminate these mistakes and careful consideration of Dr. Bridgman's material will do much to advance the knowledge of color vision and its many ramifications.

Perhaps optometrists will realize the value of color vision testing to them when they consider the development of the various color vision tests and the causes for these developments.

Tests of color vision have been in use for more than a century. The development of such tests have been closely related to the

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development of transportation methods such as railroads, shipping, air travel, etc., because of the colored signal systems used by these industries. Emphasis is placed on color testing and development of color tests in time of war for the same reason.

At present, industry, too, has a keen interest in the testing of color vision. Color coding is used in electric wiring and other supply pipes. Color printing and color photography have become increasingly important. Mixing of color dyes and paints is definitely a color job and the development of these industries in the United States since World War I, has been constant. The importance of color in industry and transportation has risen steadily during the past 30 years. Naturally interest in testing of color vision has risen accordingly.

While there are a large number of color tests available for use no one test has been accepted as satisfactory for all situations. The variability of types of color judgments required in various situations is sufficient to rule out a single test which can be used as a test of color ability. Practice usually demands that the test setting bear an obvious relationship to the practical problem to which the test results are to be applied. Hence a test which selects individuals who are capable of recognizing and differentiating color signal lights will not necessarily select individuals who can look at a full color picture and make a decision as to its color balance. The test must be selected to represent the type color judgment required in an actual job situation.

In reviewing the various types of color tests now in use we must consider both the theoretical and practical value of the test: i.e., what does the test measure and what relationship is there between this measurement and actual color judgments required of individuals in everyday life or on the job.

Color tests may be divided into five types:

1. Color naming or lantern type tests.
2. Matching—anomaloscope.
3. Sorting—Holmgren wools.
4. Hue and chroma classification—laboratory tests of L.N.D.
5. Discrimination and sensitivity—pseudo isochromatic charts.

They may be either qualitative or quantitative. Qualitative tests are designed to separate individuals into pass and fail categories. The dividing line may be either strict or lax. Quantitative tests are designed to select color deviates and the degree of deviation from the so-called "normal." At present there appears to be a need for classification of

"normals" by degree of sensitivity and design work is in progress for such a test.

Tests of all the above types are now in use. Each type has its advantages and disadvantages. In selecting a test it is wise to consider all of the information available.

It is unfortunate that much of the experimental material gathered during the war has not been collected in one publication. From that material it is hoped that someday we shall have a test or tests by which we can analyze color vision and from such an analysis rate individuals on the basis of their ability to discriminate color.

BAUSCH & LOMB OPTICAL CO.
ROCHESTER, NEW YORK

MONOCULAR AMBLYOPIA EX ANOPSIA IMPROVED BY ASTIGMATIC CORRECTION AND ORTHOPTIC TRAINING— A CASE REPORT*

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Patient, boy age 11, received notice through school that his left eye was poor. He has had no visual complaints.

As far as could be ascertained from his mother he is in the best of health and always has been so. He has had several pairs of glasses prescribed but none of these seemed to help his condition. He has also used occluders on several occasions.

The patient's lid margins were slightly inflamed but with no discharge. His cilia were normal, puncta normal, cornea clear, pupil outline round and clearly defined. Media clear, right disk well defined with 1½ mm. cup about in the center. General fundus color good. Vessels pursue normal course and are of normal caliber. Macula area clear with yellow spot clearly defined. No apparent lesions in fundus. Left eye essentially the same.

ANALYTICAL EXAMINATION

Static retinoscopy

O.D. —0.75 D. cyl. axis 105
O.S. —3.00 D. cyl. axis 95

Dynamic retinoscopy

O.D. +1.25 D. sph. ⊂ —0.75 D. cyl. axis 105
O.S. +1.25 D. sph. ⊂ —3.00 D. cyl. axis 95

Subjective findings

O.D. —0.25 D. sph. ⊂ —0.50 D. cyl. axis 100. V.A. 20/20
O.S. —0.75 D. sph. ⊂ —1.25 D. cyl. axis 105. V.A. 20/40

Phoria at distance: 2 esophoria.
Convergence at distance: 20/8.
Divergence at distance: 6/4.
Vertical phoria: 0.
Vertical ductions: Normal.

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Phoria at near-point with subjective finding: 2 esophoria.
Fused cross cylinder at 20 inches. O.D.+1.00. O.S.+0.50.
Phoria at near-point with above: 0.
Convergence at 20 inches through distance subjective: 16/8.
Divergence at 20 inches through distance subjective: 20/10.
Tolerance to minus lenses through distance subjective: —0.50 D. sph.
Tolerance to plus lenses through distance subjective: +1.00 D. sph.

The Keystone visual skills series showed no suppression but very poor vision in the left eye. In spite of this the patient's stereopsis was fairly high.

Glasses were not prescribed immediately. It was considered that orthoptic training would be necessary to bring the vision of the left eye to normal or near normal. Knowing the family's economic condition we thought that after a few training periods the patient's cooperation would increase to a point where a more thorough and accurate examination could then be made and thus save the patient's family the cost of a "too temporary correction."

After four training periods principally on rotations, a second refraction was made.

Subjective findings

O.D.+0.50 D. sph. ⌒ —0.75 D. cyl. axis 105. V.A. 20/20.
O.S.+0.50 D. sph. ⌒ —2.50 D. cyl. axis 110. V.A. 20/40.

The other findings were essentially the same as already reported.

It will be noted that both eyes now accept plus sphere, as compared to minus sphere on the previous examination. Also the cylinder in the left correction has increased considerably, now approaching the cylinder as determined by static retinoscopy.

This subjective correction was prescribed for constant wear and the orthoptic training was continued. This consisted of rotation training and fusion training to which was later added perception training, i.e., tracing, V bars, tachistoscope.

After a total of 15 training periods it was found that the previous refractive findings were essentially unchanged but now the patient's visual acuity was O.D. 20/20, O.S. 20/20, corrected.

Two years later his corrected visual acuity was the same.

SUMMARY

A case of monocular amblyopia ex anopsia is presented. Occluders failed to improve vision which was brought to normal by means of a correction for astigmatism and orthoptic training.

A CLINICAL SURVEY OF SPHERICAL ABERRATION*

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INTRODUCTION

This survey was conducted in order to gain an evaluation of the clinical manifestations of the spherical aberration of the eye and to search for a guide that will enable us to modify our prescriptions to compensate for the effects of spherical aberration under the varying conditions of seeing which the patient may encounter outside the refracting room. No attempt was made to demonstrate the influence of spherical aberration on the accommodative-convergence relationship of the eyes as was ably done by Morgan[1] in a laboratory investigation.

PREVIOUS INVESTIGATIONS

Tscherning[2] investigated the spherical aberration of his and his student's eyes by means of his aberroscope and the optometer of Thomas Young and also by a technique of objective stigmatoscopy proposed by Jackson. Brudzewski[2] used a laboratory ophthalmometer and found the spherical aberration of the cornea to vary in different zones of the same eye from +3.0 D to —1.5 D. Stadtfeldt[2] used a dissected crystalline lens and found that there was an aplanatic 4 mm. central zone. This conforms to the opinion of Gullstrand[3] who considered the variable index of the crystalline lens to have little or no effect on the refraction of paraxial rays and hence to not correct the spherical aberration produced by the corneal surfaces to any extent. Gullstrand with a method of objective and subjective stigmatoscopy found a maximum of 4.D of spherical aberration and stated the average spherical aberration along the axis to be 1.5 D for a "moderate" size pupil.

Ames and Proctor[4] investigated the spherical aberration in the different zones of the eye and found the greatest positive spherical aberration to be in the zone contained within radii of 1.5 to 2 mm. from the axis. In none of their series of observations did they find a spherical aberration in any one zone greater than 0.75 D. Gliddon[5] constructed an optical replica of the eye and calculated the axial spherical aberration with a 4 mm. aperture (4.4 mm. apparent pupil) to be

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†Optometrist.

—0.3874 mm. (1.0 D). With this replica mounted on a lens bench he examined the image of a point source‡ with microscopes of 100X and 300X magnification. Observation of the image with the high-powered objective disclosed a spherical aberration of —0.4 mm. or 1.0 D of positive spherical aberration. The low-powered objective disclosed —0.3 mm. or 0.75 D. The concentration of the light that formed the image was seen to be all on the axis with little in the circle of diffusion caused by the spherical aberration. Ames and Gliddon[6] in investigations with a laboratory haploscope found an average axial spherical aberration of .45 D for a 6 M. fixation (3 subjects; 6 eyes). Luckiesh and Moss[6] determined the refraction of the eye both with their sensitometer and by conventional subjective technique and found an average difference of 0.75 D which is essentially a manifestation of spherical aberration.**

Morgan[1], in a laboratory investigation with a haploscope of 50 students between the ages of 20 to 30, found a range of spherical aberration from 0.5 D to 1.5 D and an average of 0.75 D. Byram[8] used a method slightly different than that of Ames and Proctor to investigate his eye and found spherical aberrations of +0.2, +0.4 and +1.0 diopters at zones 1.5, 2.0 and 3.0 millimeters from the center of his pupil.

van Heel[9] designed a series of optical systems that corrected the spherical aberration of the eye and used them to improve the observations with a trichromatic colorimeter. Monnier[10] advocated compensating for spherical aberration by the addition of —1.5 D to the distance prescription to give better visual acuity in night driving.

DETAILS OF PRESENT INVESTIGATION

The subjects used for this study were 100 consecutive patients whose corrected visual acuity was 20/20 or better and whose apparent pupil was 3 mm. or greater. The age limits of the group were 11 and 67 years and the ages of 75 per cent of the subjects fell between the limits of 18 and 47 years. The diameter of the apparent pupil was estimated in the following manner. The attention of the subject was directed to a distant fixation point and the pupil was illuminated by a skiascope beam just bright enough to produce a reflex. An ivory rule

‡0.75 mm. diameter light at 75 ft.

**M. W. Morgan, Jr., is of the present opinion that this difference is not entirely due to spherical aberration but that the Purkinje Shift, dark adaptation and a change in index with the wavelength may also account for the difference.—Personal communication.

held in the frontal plane, in contact with the subject's nose, and at the level of the lower pupillary border served as a scale with which to estimate the pupillary diameter. By this method it was possible to obtain readings to within ½ mm.

The flat plano lens that served as the haploscope mirror was mounted on the arm of the refractor that normally positions a battery of Maddox rods before the right eye. The glass rods were removed to give an aperture of 15 mm. and the plano mirror was attached to the temporal rim of the rotating brass plate by means of a hinge. A lens cell which held two trial case lenses was attached to the nasal margin of the same plate. This allowed the mirror to be rotated about a vertical axis and the plate carrying the mirror and lens cell to be rotated about an axis coincident with the line of sight of the subject. A housed 3.8 volt skiascope bulb shining through a pinhole served as a point source of light. The light housing was attached to the distal end of the supporting refractor arm at a distance of .85M from the lens cell. The elevation of the light source could be adjusted so that it was in the

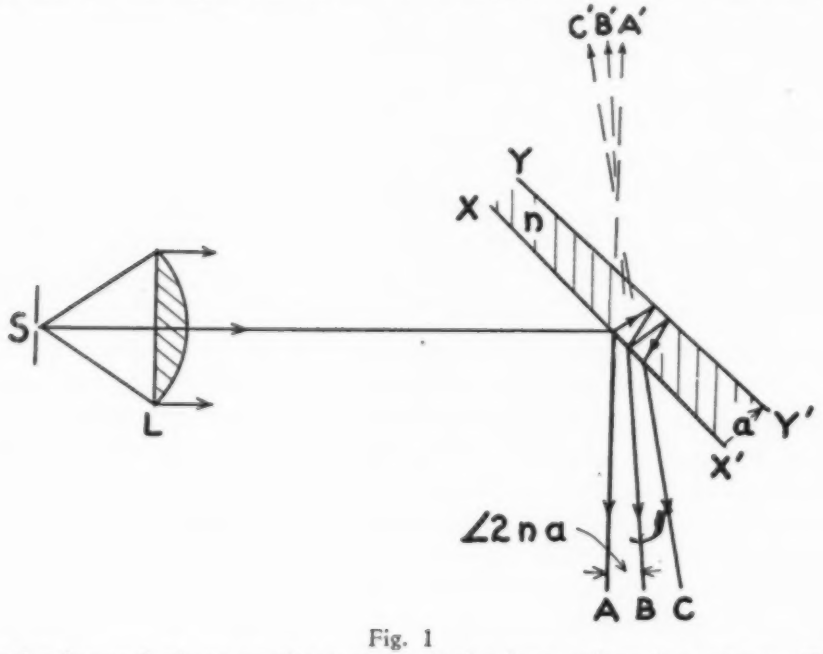

Fig. 1

same horizontal plane as the centers of the lens cell and aperture. The right and left eyes of the subject were made clinically emmetropic*

*The lens prescription was used that gave maximum visual acuity with the least concave or most convex spherical lens power.

and his attention was directed to a single horizontal row of 20/20 letters projected on the wall chart. The plano lens that served as a haploscope mirror contained slightly less than 0.1 D of prismatic power and as a result it produced a multiple image of the light source. Light from the source at S (Figure 1) after passing through the collimating lens L strikes the surface XX′ of the mirror and is partially reflected in the direction A. A remaining portion of light is refracted at surface XX′ and part of it is internally reflected at surface YY′ and again refracted at XX′ in the direction B. In a similar manner if the intensity of the source is sufficient a pencil of rays produced by two additional internal reflections is refracted in the direction C from surface XX′. The result was that the subject saw a series of images of the light source that diminished in intensity in the direction of the apex of the prism.

The haploscope mirror was adjusted so that the images of the light source were on the unilluminated portion of the chart and just below a horizontal line of 20/20 Snellen letters. If the subject saw only two images of the source, the intensity of the source was increased by means of a rheostat until he saw a third image. The intensity was then decreased just sufficient to cause the extinction of the third image. Spherical trial case lenses were placed in the lens cells until the patient reported the images of the point source were smallest. The observer was told to look at the line of 20/20 letters frequently to see if they retained their original clarity. The measurement was first made with the left eye occluded and then with both eyes viewing the letters. In four of the 100 subjects examined the haploscope lens that formed the sharpest

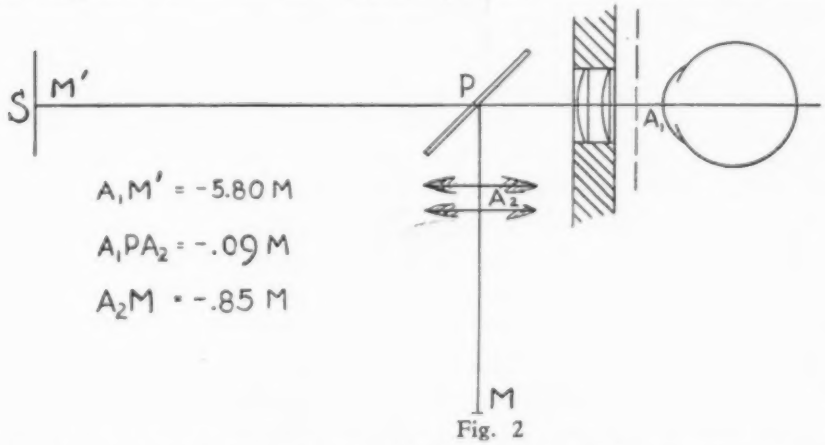

Fig. 2

image when the left eye was occluded was 0.12 D less convex than the lens required when both eyes viewed the Snellen letters.

The light from the source at M (Figure 2) is converged by the trial case lenses at A_2 and partially reflected into the eye by the haploscope mirror P. If the focus of the lens at A_2 is +1.0 D the virtual image of M will be at M′, a distance of 5.8 M from the subject's eye, and conjugate with the screen S. While the subject watched the 20/20 letters and the images of the light source on the screen weak convex or concave lenses were placed in contact with the collimating lens at A_2 until he reported the images of the light source to be of smallest diameter. When he reported this the conoid of image rays from the point source had been placed so that the retina lay in the plane B (Figure 3).

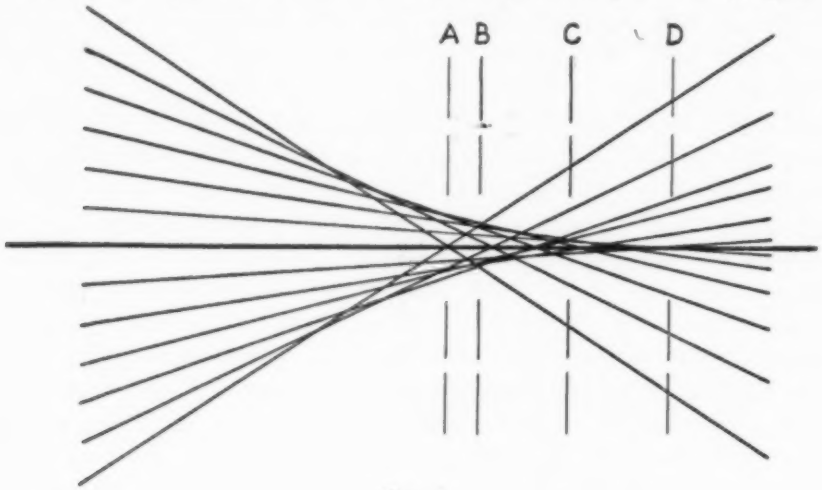

Fig. 3

Many good observers spontaneously offered the information that the images were fringed with blue or orange if the power of the haploscope lens was too great or too little to place the waist of the conoid on the retina. Such a phenomenon is due to chromatic aberration but the observed chromatism served as a cue to place the waist of the conoid on the retina if the eye was under or over corrected for both spherical and chromatic aberration. In this survey the subject selected one combination of lenses that focused image rays from the Snellen letters so that the retina cut the conoid in the plane C.* A different lens combination was selected to put the waist of the conoid of image rays from the point source at the retina. If an attempt was made to shift the position of the image rays from the Snellen letters so that the plane of the retina was at B, the subject in most cases reported a diminished

*The position of plane C relative to B and D is not necessarily as shown in Figure 2. It might lie even to the right of D for some subjects.

acuity. This point is noteworthy because we would suppose that any change in the focus of the eye that would reduce the size of the diffusion disks on the retina would increase the subjective clarity of the image.**

The dioptric equivalent of the interval B C is the quantity that was measured in this survey and is designated in this paper by the symbol SA. The measure of SA will be the difference in vergence at A_1 (Figure 2) of the two systems of image rays. One system will come from S and be refracted by the lenses in the refractor and the other will issue from M, be refracted at A_2, reflected by the mirror P and refracted by the refractor lenses. If the subject selected a concave lens in contact with the collimating lens to form the smallest images of the point source his SA was recorded as positive. Along with the values of the subject's SA. records were made of the following clinical measurements: static skiametry, ophthalmometer, the equivalent sphere of the subjective finding, monocular cross-cylinder, monocular amplitude of accommodation, apparent pupil, and the subject's age.

RESULTS

Table I is a summary of the results of the various investigators in the field and although different sets of findings cannot be compared too critically due to differences in technique there is seen to be a wide range of values. The techniques of Ames & Gliddon, Morgan and this writer were sufficiently similar that they will stand comparison. It might be

TABLE I

Investigator	*Range*	*Average Spherical Aberration*
Brudzewski	+3.0 to —1.5 D	.....
Gullstrand	+4.0 D maximum	+1.50 D
Ames & Proctor	+0.75 D maximum	.....
Gliddon	(Schematic eye)	+1.00 D
Ames & Gliddon	+0.1 D to +0.83 D	+0.45 D
Luckiesh & Moss	.....	+0.75 D
Morgan	+0.50 D to +1.5 D	+0.75 D
Byram	.....	+1.00 D
Monnier	.....	+1.50 D
Elvin (present study)	—0.38 D to +1.32 D	+0.27 D

**Both Tscherning[2] and Helmholtz[3] believed that the eye is focused so that the retina cuts the conoid where the caustic has the least diameter. Ames and Proctor[4] believed that the eye is focused so that the retina cuts the conoid at the section of smallest diameter. Byram[9] stated that "the eye would accommodate so that the retina would coincide with the plane in which the distribution function (of the light incident on the retina) gives a maximum contrast for the object under observation." This would require a varying accommodation of the eye for different objects and levels of illumination in order to attain maximum resolving power. This writer is in agreement with such a hypothesis.

well to point out that the correction of the basic refractive state greatly influences the SA finding. If the refractionist tends to be "heavy with the plus" in determining the subjective prescription all positive SA findings would be increased by +0.25 D. The mean value of the SA in this survey for 100 eyes was +0.27 D. The range was from —0.38 D to +1.32 D and the Standard Deviation of the group was 0.24.

The SA findings were grouped by 0.12 D intervals and the arithmetic means of the corresponding clinical measurements listed above were determined. The mean of each group of measurements was plotted against the SA and the coefficient of linear correlation was computed. The only significant correlations were with the apparent pupil (.43), and the difference between the subjective and skiametric findings (.31) and the subjects age (.27).

The technique of the operation limited us to one determination of SA for each subject as we had no way of varying the pupil size. Inasmuch as the optical constants of the eye do not vary greatly from individual to individual it is permissible to study the relationship between SA and pupil size of the group and deduce from that the influence of the pupil on the SA of a single eye.

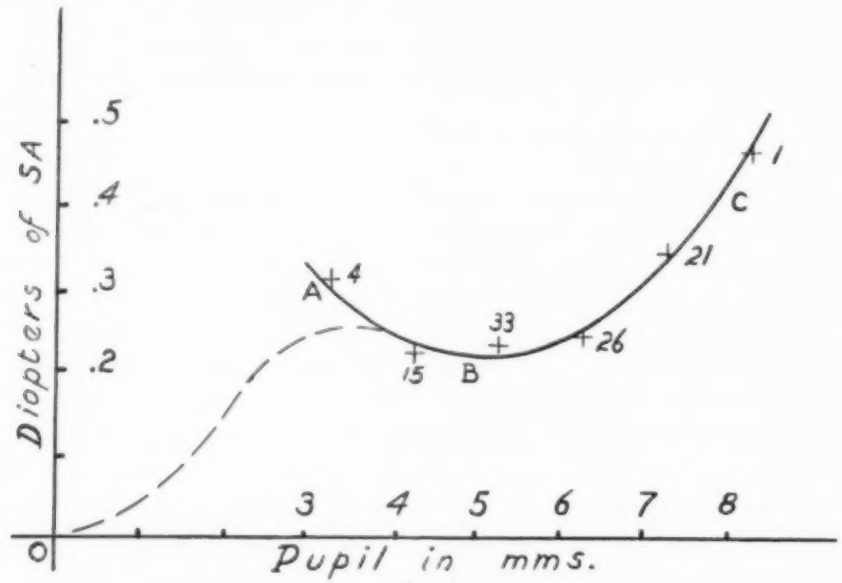

Fig. 4

The data was regrouped by pupil size and the mean value of SA for each group was plotted against the corresponding apparent pupil to give the set of points in Figure 4. The numbers on the graph that

are close to the +'s refer to the number of subjects in each group. The solid line is the parabola that was fitted to the points by the method of least squares[11]. If the technique used had allowed us to obtain points for pupils of smaller size than 3 mm. we would expect a point of inflection near A or B so that the left leg would pass through or near the origin.

DISCUSSION

An extrapolation of the data along the broken line would give a smooth curve that passes through the origin with a maximum value for SA between 3 and 4 mm. Such an extension is in agreement with the definition of spherical aberration* and the findings of Ames and Proctor[4] who used a technique that permitted an investigation of a zone as close as 0.5 mm. from the optic axis. From such a curve it can be seen that there is little variation in SA due to pupillary size until the apparent pupil exceeds 6 mm.

In very dim light the pupillary diameter exceeds 6 mm. and we would expect a further increase in SA. This would account for that portion of "twilight myopia" not caused by the Purkinje Shift which Wald and Griffin[13] estimate to be from 0.35 D to 0.40 D. The Purkinje phenomena were inoperable in this survey because the investigation was restricted to the rod free area of the retina.

We are all unaware of a constant amount of spherical aberration and the acuity of the 63 per cent of the group whose SA did not exceed 0.25 D is not diminished by the effect of spherical aberration under all but very low levels of illumination. Those patients whose SA exceeds 0.25 D should be given due consideration when their prescription is written, particularly if they are to perform visual tasks at low levels of illumination. If the patient is given a distance prescription that places the waist of the conoid within 0.25 D of the retina the amount of spherical aberration would be constant and insignificant at all but very low levels of illumination and the resolving power of the eye would be at a maximum for normal conditions of seeing.

SUMMARY

An approximation of the spherical aberration of 100 eyes was determined by means of a simple clinical haploscope. All subjects had a corrected visual acuity of 20/20 or better.

*Spherical aberration is defined as the linear distance between the intersections on the axis of marginal and paraxial rays. (12)

One-third of the subjects exhibited a clinical manifestation of spherical aberration exceeding +0.25 D.

This clinical spherical aberration can be quickly and accurately determined with a simple haploscope. It cannot be predicted from any single routine clinical test or from any combination of routine tests.

An alteration of the distance prescription to partially compensate for spherical aberration will maintain the acuity at a maximum over lower levels of illumination than those encountered in the refraction room.

This alteration is in the form of a reduction of convex or an increase in concave lens power.

REFERENCES

1. Morgan, M. W., Jr., Accommodation and its Relationship to Convergence. Amer. J. of Optometry, 21:5, 183, 1944.
2. Tscherning, M., Physiological Optics. The Keystone Publishing Co., Philadelphia, 1904, pp. 95-108.
3. Gullstrand, A., Appendix to Helmholtz, H. L., Helmholtz's Treatise on Phys. Opt., translated by J. P. C. Southall, George Banta Publishing Co., Minasha, Wis., Vol. I, 1924, pp. 416-443.
4. Ames, A. Jr. and Proctor, C. A., Dioptrics of the Eye, J. Opt. Soc. America 5:22, 84, 1921.
5. Gliddon, G. H., Archives of Oph., 2: 138-13, 1929.
6. Ames, A. Jr. and Gliddon, G. H., Ocular Measurements, Trans. Sect. Oph. A. M. A. 26: 1, 1928.
7. Luckiesh, M. and Moss, F., The Science of Seeing, Van Nostrand & Co., New York, 1937, pp. 485-511.
8. Byram, G. M., The Physical and Photochemical Basis of Visual Resolving Power. J. Opt. Soc. America. 34:10, pp. 571-591, 1944.
9. van Heel, A. C. S., Correction Spherical and Chromatic Aberrations of the Eye. J. Opt. Soc. America, 36:4, pp. 237-239, 1946.
10. Monnier, A. M., Contribution to the Study of Twilight Myopia (Compt. rend. Soc. de Biol. 137:732-2, 1943), in Quat. Rev. Oph. 1:2, 1945.
11. Ford, W. B., A Brief Course in Analytical Geometry, Henry Holt & Co., New York, 1924.
12. Southall, J. P. C., Mirrors, Prisms and Lenses, The MacMillan Co., New York, 1936, p. 513.
13. Wald, G. and Griffin, D. R., The Change in Refractive Power of the Human Eye in Dim and Bright Light. J. Opt. Soc. America, 37:5, pp. 321-336, 1947.

CONVERGENT STRABISMUS CORRECTED BY LENSES AND OTHOPTICS—A CASE REPORT*

Leon E. Firestone†
Detroit, Michigan

CASE HISTORY

Patient: Male, age five.

Ocular History: Eyes turned in when patient was three years old. Up to that age eyes seemed perfectly normal. Patient apparently subject to considerable lacrimation. An ophthalmologist prescribed glasses at the age of 3½ years, and recommended surgery at 4 years, but no surgery was performed.

Health History: Patient had measles at 3 years of age.

Family History: Mother and father do not wear glasses. There is no evidence of other members of the family suffering from strabismus.

Social and Recreational History: Child played normally with others in the neighborhood.

Complaint: Mother, "We have had glasses on Tommy 1½ years and his eyes do not seem to improve. My doctor wants to operate but I heard you can take care of it by exercise. His eyes seemed perfectly good until a short time after he had measles when they turned in."

PRELIMINARY FINDINGS

External Examination:

Lids: Slight blepharitis, cilia fairly heavy, conjunctiva smooth with no injection.

Superficial cornea: Normal.

Superficial sclera: Normal.

Versions: Eyes do not move concomitantly but have full power of excursion.

Rotations: Good.

Pupillary Reaction to Light:

Direct: Normal.

Consensual: Normal.

Pupillary Reaction to Accommodation: Normal.

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†Optometrist. Fellow, American Academy of Optometry.

OPHTHALMOSCOPIC EXAMINATION (Direct)

Cornea: Clear. O.D. and O.S.
Aqueous: Clear. O.D. and O.S.
Lens: Clear. O.D. and O.S.
Vitreous: Clear. O.D. and O.S.

Fundus: General pinkish, condition good. Disc: Margin well defined, physiological cupping present. Course of arteries and veins straight. Proper arterio-venous ratio, venous pulsation present.

ANALYTICAL EXAMINATION

Visual acuity (without correction) O.D. 20/25. O.S. 20/25. O.U. 20/25.

Visual acuity (former correction) O.D. 20/25. O.S. 20/25. O.U. 20/25.

Visual acuity (new correction) O.D. 20/25. O.S. 20/25. O.U. 20/25.

Ophthalmometer: O.D. plano. O.S. 50 x 90.

Retinoscopy. Static.

O.D. + 4.50 D. sph. V.A. = 20/50
O.S. + 4.50 D. sph. ⌒ + 0.50 D. cyl. x 90. V.A. = 20/50

Retinoscopy. Dynamic: Impossible to secure findings.

Subjective tests. 6 M.

O.D. + 3.50 D. sph. V.A. = 20/25.
O.S. + 3.50 D. sph. ⌒ + 0.50 D. cyl. x 90. V.A. = 20/25

Subjective tests. 33 cm. Impossible to secure findings.

Binocular tests: Impossible to secure findings because of suppression.

The patient suppresses O.S. This was determined by attempting to cause diplopia with vertical prism. Also star-and-circle, and cat-in-cage test on tel-eye-binocular.

Fusion: None.

Stereopsis: None.

Color vision: Normal.

Measurement of squint by Javal's method, 20 degrees.

DIAGNOSIS

Patient has 20 degrees left convergent functional strabismus. No pathology. He is hyperopic in the right eye and has compound hyperopic astigmia in the left eye. Patient suppresses left eye but has no amblyopia.

RECOMMENDED TREATMENT

Patient is to use his present glasses and is to have orthoptic treatments three times a week for a period of 15 to 20 minutes. Treatments to continue until suppression is eliminated and fusion is established.

TREATMENT TECHNIQUES

Orthoptic treatment was started on June 12, 1944. The correction of the patient's old lenses were sufficiently close to my findings to allow him to use them.

I spent approximately three weeks breaking down suppression. Using the tel-eye-trainer I presented targets of the star-and-circle, Humpty-Dumpty-and-wall, bird-and-cage with fast flashing simultaneous lights until he could see them together. At home I had him wear a red plastic patch over the right eye to help break down suppression. I also had him occlude the right eye and view color pictures: look in a mirror at his left eye, and bounce a ball to help in monocular skill and projection.

At the end of a month the patient had constant diplopia. I then started him on simple fusion exercises which included fusion of colors, balls, easy pictures and charts. After the patient successfully negotiated the simple targets I gradually increased the type of targets to make them more difficult but never gave him something beyond his ability. After he was able to fuse most of the pictures easily I gave him targets which required small degrees of stereoscopic vision. I used stereoscopic slides in the tel-eye-trainer to increase his ductions. He soon exhibited only a periodic squint and finally none at all.

The patient was discharged October 18, 1944, with the strabismus entirely cleared, fusion fairly good and stereopsis less than fair.

I have re-examined the child three times since his discharge and have found the fusion and stereoscopic vision improved with no tendency for the eye to deviate.

COMMENT

There are many different techniques of straightening a functional squint. The basis, however, of most of the orthoptic techniques is similar. The use of general psychology to stimulate interests must always be observed. I have found by speaking to the child who actually is not sufficiently mature to realize what type of service we are rendering him, that one can usually discover certain things in which he shows some interest. By using charts and pictures (sometimes home-made) built around what is interesting to him, one can usually control the

patient sufficiently to get good orthoptic results. I generally find that a brief orthoptic period of 15 minutes is of more value than one prolonged over that period as there is a tendency for the patient to lose interest in what he is doing if carried out too long. With children I attempt to make a game of what he is doing and not make it a task to be abhored.

There are various instruments available to perform necessary orthoptic procedure. A good foundation in the principles of physiological optics enables one to use any modern instrument with effectiveness.

Breaking down suppression usually represents one of the most difficult tasks in the process of correcting a squint case. By using a fast simultaneous flash I take advantage of the inability of the patient to suppress the after image. I have found this procedure works very well most of the time. Sometimes, however, I have to make use of other means to accomplish my results, such as putting a vertical prism on the patient to get one of the images off the fusion area and gradually decreasing the power until the patient has simultaneous vision. Varying the intensity of lights has also proved helpful.

I have found that the majority of strabismus cases do not have good stereoscopic vision even after prolonged training. As long as their fusion is good and their eyes are straight I discharge the patient. After a year or so of binocular vision in normal use the stereoscopic vision seems much improved.

SUMMARY

The writer first examined the patient when he was 5 years of age. He was found to have a left convergent strabismus for which glasses had been prescribed. A former examiner had also suggested surgery.

Orthoptic treatments were started June 12, 1944. The patient visited the office three times each week for a three month period. During this time considerable progress was made and for the remaining month of the treatment period the patient was seen only twice each week.

On October 18, 1944, the strabismus was entirely corrected. The patient has been examined on three occasions since this date and no evidence is found of strabismus. The patient continues to use his correction.

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OPTOMETRY AND ITS PLACE IN THE NEW YEAR

As the year 1948 gets under way a review of the current position in which optometry finds itself may be of interest. It may also prove of value in assisting optometrists to chart their courses of action for the months immediately ahead.

From an economic standpoint the year 1948 should continue to be one of good income. Employment remains high with no immediate prospect of a marked downsurge and as a result the national income tops any prior period. As people are generally eye-conscious and as the fee for optometic service is modest there is no reason to expect a significant reduction in the number of patients served by optometrists during 1948. The inflationary trend which followed the removal of governmental controls during 1946 should reach its peak in everything except food

in 1948, and be checked by production overtaking consumer demand.

Optometrists have increased their fees very moderately during the past several years, but in the light of present-day living increases, the optometric dollar of today is one of the nation's best values. In fact, this is one of optometry's strong points. Because of moderate fees the public continues to enjoy a high measure of eye care in good and bad economic times alike, and it is one of the factors which the profession should hold fast to in the years to come.

From a technical standpoint we shall continue to make progress. The year 1947 was significant for the public and professional confusion which raged over contact lens fitting and the abundance of over-selling which these aids to subnormal vision provoked. Experience is a painful teacher, but we now are beginning to realize the limitations of this optometric technique and before the close of the new year should find this specialty tucked away as one of the ancillary services used by optometrists on selected cases in their every day work.

The new year, too, should see a reduction in the amount of loose thinking which beclouded the entire myopia question. From the published work of Morgan, Stoddard, Hirsch and others it is clear that axial myopia exists and that it is by far the most prevalent type of myopia. It is equally clear that there is no known way of reducing the amount of this ametropia.

Further progress is being made in the correction of squint. The work of numerous investigators is hastening the day when an accurate differential diagnosis can be made in advance of orthoptic treatment. We may look for further work towards this end during the year.

From the undergraduate educational viewpoint our schools are overcoming the handicaps they faced at the end of the war. The new year will see them making further progress in this direction. Educational standards seem always open to criticism. The perfect faculty has yet to be assembled in any course or school and the curriculum which satisfies one will displease another. However, there is a strong trend towards making optometic undergraduate courses as fine as possible and our educators are to be encouraged to continue this trend.

From a sociological standpoint the public acceptance of optometrists will continue at an accelerated pace throughout 1948. The nationwide trend towards greater observance of all professional standards of practice on the part of optometrists is a factor in this towards professional recognition.

The year 1948 will bring another flood of public health proposals

as these seem to breed in election periods. The new year will seem very political even for those who realize that we live in a political world. As optometrists, we must be most cautious in approving public health programs, as each of these contains some of the elements which may undermine our American way of life.

From an organizational standpoint optometry should continue to prosper in the new year. Membership in state optometric associations is certainly a requirement for all optometrists. Collectively we can bring to a satisfactory conclusion the negotiations with the United States Veterans Administration and later with the Public Health Service. These are the two big jobs immediately ahead of the A.O.A. and can be accomplished only by united support. Optometrists should also give the new Foundation the support it requests as its program merits serious consideration.

It is clear that on every front optometry is moving forward. The prospects for the year 1948 are especially good for the practitioner who places the well-being of his patients above all other considerations. The man who refracts conscientiously, who avoids the bizarre techniques which tend to bring discredit upon the optometrist, and who practices professionally will be building a practice with a lasting future.

CAREL C. KOCH

CORRESPONDENCE

THE ANGLE OF DEVIATION IN CONCOMITANT SQUINT

To the Editor:

The following is in response to the comment made by Dr. Baxter* concerning an omission of data in my paper† which appeared in this journal in October.

The exotrope in question had slightly better than 20/20 maximum visual acuity in each eye. The test letters used to control the accommodation were designed to subtend an angle of 5′ at any accommodation level by means of a Badal optometer system. In the cases of esotropia described, the maximum monocular visual acuities were also above 20/20 and the same test letters were used in the apparatus.

I regret that I failed to state these facts in the original article.

H. W. HOFSTETTER.

*Baxter, Robert C., Jr., Correspondence, American Journal of Optometry and Archives of American Academy of Optometry, 24:11, 574, November, 1947.

†Hofstetter, H. W., Certain Variations in the Angle of Deviation in Concomitant Squint, Ibid. 24:10, 463-471, October, 1947.

TRANSACTIONS OF THE AMERICAN ACADEMY OF OPTOMETRY

A department devoted to announcements, reports, appointments, organization data, news, professional problems and ideals, as these relate to the Academy.

CHICAGO MEETING OF ACADEMY

DR. FREDERIC A. WOLL AWARDED HONORARY FELLOWSHIP

In recognition of his contributions to optometry as a teacher, scientist, writer, and practitioner, Dr. Frederic A. Woll of New York was voted an honorary life Fellowship by the American Academy of Optometry at its annual meeting held in Chicago, December 13-16.*

Inasmuch as Dr. Woll was unable to attend the meeting and receive the certificate, acceptance in his behalf was made by Dr. Robert E. Bannon of Columbia University. Presentation was made during the annual banquet by Dr. Harold Fisher, president of the Academy.

In paying tribute to Dr. Woll on behalf of the Academy, Dr. Bannon reviewed briefly his life and his many contributions to the field of optometry:

"Dr Woll was born in New York on July 8, 1874. When about 12 years old, he left school because of a bad visual problem which was later explained as uncorrected myopia. At 15, he started work as an office boy for A. J. Cross, the originator of dynamic retinoscopy, who discovered that his young employee was very myopic. Dr. Cross prescribed Woll's first correction which unfolded a new world for the young boy and interested him in the science of ocular refraction.

"During his employment with Dr. Cross, Woll submitted to many experiments conducted by the older man while he was developing dynamic skiametry. By the time Woll was 21, he was refracting in Dr. Cross's office and traveling about the country lecturing on dynamic skiametry. At 27, Woll re-entered school and was graduated with a Bachelor of Science degree from Columbia University Teachers College in 1910, and a Master of Arts degree in 1911. In 1917, at the age of 43, he received his Ph.D. at New York University.

"Although Dr. Woll has practiced optometry since 1897," Dr. Bannon continued, "the major portion of his time has been devoted to teaching, not only at Columbia University but also at the College of the City of New York. At Columbia, he was an Associate in Optometry from 1909 to 1944, and at the City College of New York he

*See Frontispiece.

taught hygiene and in 1927 became director of the Hygiene department at this college. He retired in 1944 at the age of 70.

"One of Dr. Woll's chief contributions to optometry is the size of the retinoscope mirror which he reduced from 50 mm. to 19 mm. He assisted Dr. Cross in the development of the first retino-skiameter and improved the methods of grinding lenses and polishing mirrors.

"Dr. Woll also is credited with being the first to isolate the retina by dissection, as reported in the American Anatomical Report for 1912.

"While carrying out his heavy teaching duties, Dr. Woll also devoted a great deal of time toward the improvement of optometric schools. His many activities in the educational and scientific fields include membership on the New York State Board of Examiners in Optometry since 1917, and the Committee on Education of the International Association of Board of Examiners in Optometry (1923-1942). He is a Fellow of the American Association for the Advancement of Science, and the American Physical Education Association; a member of the American Optometric Association and the American Health Association, and an honorary member of the British Ophthalmic Association, as well as several state optometric associations."

Dr. Bannon concluded his remarks with a review of Dr. Woll's writings: "Hygiene Optometrists Ought to Know," "Technique of Eye Dissections," "Syllabus in Physical Training for Elementary and Secondary Schools," "Syllabus on Optometric Education." He also co-authored five volumes entitled, "Proceedings of 4th International Congress on School of Hygiene."

Dr. Woll's Honorary Life Fellowship is the third voted by the Academy during its 25-year history. In 1945, tribute was paid Dr. A. W. Smith, Dean of the Graduate School, Ohio State University, and in 1946, to Dr. James P. C. Southall, of Charlottesville, Virginia, for outstanding contributions to visual science.

DR. HAROLD M. FISHER RE-ELECTED PRESIDENT

Dr. Harold M. Fisher, New York City, was re-elected to the office of president at the Academy's annual election in Chicago, December 15. Dr. Fisher, a faculty member of Columbia University, and a specialist in the field of aniseikonia, became president of the Academy in May, 1947, at the postponed 1946 meeting held at Philadelphia.

Also re-elected were Dr. D. G. Hummel of Cleveland, Ohio, vice-president; Dr. Carel C. Koch, Minneapolis, Minnesota, secretary-treasurer, and the following members of the Executive Council: Drs. J.

Fred Andreae (immediate past president), Baltimore, Maryland; W. Edward Dewey, Battle Creek, Michigan; Robert E. Bannon, Hanover, New Hampshire; John R. Dean, Los Angeles, California, and Laurence Folsom, South Royalton, Vermont.

WINSTON-SALEM CHOSEN CONVENTION CITY

Winston-Salem, North Carolina, was unanimously chosen the 1948 meeting place of the Academy. Genial Dr. Robert Walker, president of the North Carolina chapter, and the rest of the North Carolina Fellows (who chartered a Pullman to Chicago for the meeting), promise balmy weather and plenty of barbequed pig to eat during the convention, either of which should help ensure the success of any meeting! The meeting is scheduled, for the first week in December, subject to confirmation by Dr. Walker after contacting the convention bureau and hotels.

DELEGATES TO BERKELEY DEDICATION

In Chicago, the Executive Council voted to send three Academy delegates to the dedication services of the new optometry building at the University of California, Berkeley. The men chosen to represent the Academy are Dr. Harold Fisher, president, and the 1948 president and secretary of the Southern California chapter. The exact dedication date is not as yet known, but officials of the school tentatively plan the services for the early summer of this year.

The Council voted to rescind as of January 1, 1948, the Academy rule permitting charter members of newly formed chapters to come into the American Academy of Optometry without meeting the full membership qualifications as set up in the constitution and by-laws. After January 1, 1948, all applicants for membership in the American Academy of Optometry must meet full requirements of the Academy in order to become Fellows.

LORD CHARNWOOD ACADEMY GUEST

Registration topped all previous convention attendance at the Chicago meeting. A total of 144 optometrists and guests were present.

Included in the list of guests attending was one of England's outstanding optometrists, the Hon. Lord Charnwood of London.

Although his duties as a member of the House of Lords consume much of his time, Lord Charnwood devotes a day and a half to the London Refraction Hospital and carries on his own private practice.

Greatly interested in the field of aniseikonia, which has not as yet

LORD CHARNWOOD

been developed in England, Lord Charnwood attended the convention for the purpose of conferring with the Academy's aniseikonic leaders, as well as to hear the other lectures presented during the four-day session.

In discussing optometry with Academy members, Lord Charnwood commented that American optometrists employ more instruments in their practices than do English practitioners. He believes that both English and American optometrists would be better off if they gave up dispensing entirely.

The Chicago trip is the second to America for Lord Charnwood, the first being made in a small boat manned by himself and a friend. At that time, the two men sailed across the Atlantic in this small craft, going through the Panama Canal to Lima, Peru, where they were when World War II broke out. Upon receiving the news of Hitler's invasion of Poland, they sold the boat, and immediately returned to London via New York City.

Prior to the passage of the new English health act, Lord Charnwood spent a great deal of time in the House of Lords working and speaking in behalf of optometry. He is the only member of the House

of Lords who practices optometry. Journal readers will find some of his comments on the bill in the April, 1947, issue.

COLONEL GORIUP BANQUET SPEAKER

Colonel O. F. Goriup, Army Medical Corps officer in charge of administering the recently-passed bill commissioning optometrists in the army, was the guest speaker at the annual banquet, Monday, December 15.

After pointing out that insufficient time has passed since the bill became a law to work out all the necessary details governing covering rank, seniority, ratings, etc., Colonel Goriup assured Academy members that the Army looks forward to working with optometrists in the new specialist corps. The work of refractionists will be recognized and compensated in the service, he said.

Colonel Goriup urged that younger qualified optometrists enter the service at once—the maximum age limit at the present time being 30.

Dr. Ward Ewalt, Jr., Pittsburgh, Pennsylvania, recently appointed optometric adviser to the new specialist corps, introduced Colonel Goriup at the banquet.

The 1947 banquet was preceded by a special reception hour for Academy members, their wives and guests.

Lord Charnwood, London, England, spoke briefly at the banquet, thanking Academy members for the hospitality shown him during his stay in Chicago.

CHAPTER PROBLEMS DISCUSSED AT SPECIAL DINNER

An innovation at the Academy meeting was a dinner for Academy officers, the Executive Council, officers and delegates of the Academy's fourteen chapters. Over 50 guests were present at this dinner. Dr. W. Edward Dewey, Battle Creek, Michigan, presided at the meeting.

Following dinner, representatives of each chapter spoke briefly on the activities of their chapter and the problems encountered during the past year. While time was too short to discuss these problems at any length, Dr. Carel C. Koch, Academy secretary, in answer to questions of chapter delegates, pointed out that (1) chapter membership requirements may be higher than those of the parent body, but never lower, and (2) where a chapter exists, candidates for Fellowship in the American Academy of Optometry must first have approval of the chapter before admittance to the parent body.

Two deviations from normal convention routine were made at the Chicago meeting with definite success: Opening of the convention

on Saturday rather than Sunday, and holding two-hour section meetings each afternoon of the convention instead of only one evening. Although there was some difference of opinion on whether the Academy should open its annual meeting on Sunday or Saturday, the majority voted for Saturday.

Present plans also are to continue the new system of section meetings, which met with almost unanimous approval by Academy members.

ACADEMY TO CERTIFY CONTACT LENS SPECIALISTS

One of the most significant actions to result from the annual meeting at Chicago was taken by the contact lens section. Under the direction of Dr. John C. Neill, Philadelphia, the section drew up a resolution for approval by the Executive Council relating to optometrists who engage in the fitting of contact lenses.

In its resolution the section went on record requesting establishment of a special examining board to screen and examine members of the Academy in the specialized work of contact lens fitting and to award those members who met the qualifications and passed the examinations a special diploma certifying to their knowledge and skill in this specialty.

The resolution specified that no contact lens specialist be exempt from the examining provisions and that the first examining committee be composed of faculty members who are now teaching the fitting of contact lenses in our optometric schools. The resolution further provided that the section would limit its activities to members of the Academy and appoint and conduct its own examining committee.

This resolution was approved by the Executive Council, and the section is now working on the administrative detail necessary to get the examining board set up.

PAPERS PRESENTED

During the four-day session, the following optometrists and educators presented papers which will be published in the Journal during the coming months.

Dr. Meredith W. Morgan, Jr., Berkeley, California; Dr. J. C. Neill, Philadelphia, Pennsylvania; Dr. Paul Boeder, Southbridge, Massachusetts; Dr. Roy Marks, Dayton, Ohio; Dr. Julius Neumueller, Philadelphia, Pennsylvania (read at the convention in Dr. Neumueller's absence by Dr. Harold Simmerman); Dr. William Walton, Jr., Philadelphia; Dr. Mathew B. Alpern, Cleveland, Ohio (presented for Dr.

Alpern by Dr. Henry W. Hofstetter); Dr. Frederick Sinn, Philadelphia; Dr. Eugene Freeman, Chicago, Illinois; Dr. Leon E. Firestone, Detroit, Michigan; Dr. Herbert G. Mote, Columbus, Ohio; Dr. J. D. Kratz, Philadelphia; Dr. Norman B. Hays, Niagara Falls, New York; Dr. V. J. Ellerbrock, Columbus, Ohio; Dr. J. S. Nupuf, Canton, Ohio; Dr. Glenn A. Fry, Columbus, Ohio; Dr. Ralph E. Wick, Rapid City, South Dakota; Dr. Charles S. Bridgman, Columbus, Ohio; Dr. Monroe J. Hirsch, Columbus, Ohio (co-authored by Dr. Frank W. Weymouth, Stanford University School of Medicine); Dr. Irvin Borish, Kokomo, Indiana, and Dr. Henry W. Hofstetter, Columbus, Ohio.

Dr. Harold Simmerman, who arranged a splendid program for the Chicago annual meeting in less than six months' time, was reappointed Program and Papers committee chairman for the 1948 annual meeting by Academy president Dr. Harold Fisher.

At the final business session, Academy members gave a rising vote of thanks to Dr. Simmerman and to all speakers presenting papers at the 1947 meeting for the time and effort expended by them in making the annual 1947 meeting so successful.

VIRGINIA HUCK.

REGISTRATION AT ANNUAL MEETING OF ACADEMY

Chicago, Illinois—December 13-16, 1947

Dr. J. Fred Andreae, Baltimore, Maryland; Dr. Don B. Arden, Montevideo, Minnesota; Dr. Harry C. Armstrong, Champaign, Illinois; Dr. Robert E. Bannon, Hanover, New Hampshire; Dr. O. J. Bebber, Denver, Colorado; Dr. Anna Berliner, Chicago, Illinois; Dr. N. A. Bixler, Decatur, Indiana; Dr. Howard D. Blue, Chicago, Illinois; Dr. Paul Boeder, Southbridge, Massachusetts; Dr. I. M. Borish, Kokomo, Indiana; Dr. J. J. Brady, Sheldon, Iowa; Dr. Grace Stevesson Bragg, Chicago, Illinois; Dr. Charles S. Bridgman, Columbus, Ohio; Dr. W. E. Brown, Elgin, Illinois; Dr. Milton A. Bursack, Fargo, North Dakota.

Dr. Dorothy L. Calhoun, Forest City, North Carolina; Dr. J. T. Campbell, Washington, North Carolina; Lord Charnwood, London, England; Dr. Mary Clay, Fort Wayne, Indiana; Dr. Harold Cline, Elkhart, Indiana; Dr. Jerome B. Conlogue, Peoria, Illinois; Dr. Paul L. Connolly, Detroit, Michigan; Dr. J. C. Copeland, Chicago, Illinois; Dr. J. P. Davey, Indianapolis, Indiana; Dr. John R. Dean, Los Angeles, California; Dr. Roy Denny, Indianapolis, Indiana; Dr. W. Edward Dewey, Battle Creek, Michigan; Dr. V. J. Ellerbrock, Columbus, Ohio; Dr. Otto R. Engelmann, Chicago, Illinois; Dr. J. Erlanger, Edmonton, Alberta, Canada; Dr. H. Ward Ewalt, Jr., Pittsburgh, Pennsylvania; Dr. Richard Feinberg, West Lafayette, Indiana; Dr. William Feinbloom, New York, New York.

Dr. Leon Firestone, Detroit, Michigan; Dr. Harold M. Fisher, New York, New York; Dr. Lawrence Fitch, Newton, Pennsylvania; Dr. Laurence P. Folsom, South Royalton, Vermont; Dr. Russel Z. Franklin, Sheboygan, Wisconsin; Dr. Don E. Frantz, De Kalb, Illinois; Dr. Benton Freeman, Allentown, Pennsylvania; Dr. Eugene Freeman, Chicago, Illinois; Dr. Glenn A. Fry, Columbus, Ohio; Dr. Harry L. Fuog, Los Angeles, California; Dr. P. W. Green, Mt. Airy, North Carolina; Dr. William Greenspon, Bluefield, West Virginia; Dr. C. L. Grigware, Grand Rapids, Michigan; Dr. D. E. Grim, Cedar Rapids, Iowa; Dr. J. H. Grout, Chicago, Illinois; Dr. R. M. Hall, Cleveland, Ohio; Dr. Clyde J. Hathaway, Pontiac, Michigan.

Dr. Norman B. Hays, Niagara Falls, New York; Dr. Wayne Helmbrecht, Warren, Pennsylvania; Dr. Monroe J. Hirsch, Columbus, Ohio; Dr. H. W. Hofstetter, Columbus, Ohio; Dr. T. E. Holleman, Winston-Salem, North Carolina; Dr. D. G. Hummel, Cleveland, Ohio; Mr. Fred W. Jobe, Rochester, New York; Dr. C. D. Jordan, Peru, Indiana; Dr. Carl A. Kauffman, Suffolk, Virginia; Dr. George W. Keevil, Toronto, Ontario, Canada; Dr. J. L. Kehoe, Flint, Michigan; Dr. F. J. Kellogg, Mason, Michigan; Dr. James B. Kirk, Adrian, Michigan; Dr. Arthur S. Kitchen, Clearwater, Florida; Dr. Carel C. Koch, Minneapolis, Minnesota; Dr. J. Donald Kratz, Souderton, Pennsylvania.

Dr. G. L. Lang, Concord, North Carolina; Dr. W. W. Lansche, Elkhart, Indiana; Dr. Robert G. Ledig, Indianapolis, Indiana; Dr. Joseph V. E. Lennon, South Bend, Indiana; Dr. F. Stanley Leverich, Aurora, Illinois; Dr. Robert A. Major, Shelbyville, Indiana; Dr. Roy Marks, Dayton, Ohio; Dr. John E. Martin, Carroll, Iowa; Dr. M. A. Marvelli, Eau Claire, Wisconsin; Dr. Bernard Mazow, Houston, Texas; Dr. O. L. McCulloch, Holyoke, Massachusetts; Dr. John W. Mogey, Flushing, New York; Dr. Glenn H. Moore, Chicago, Illinois; Dr. Meredith W. Morgan, Jr., Berkeley, California; Dr. Herbert G. Mote, Columbus, Ohio.

Dr. Clifford E. Myers, Rock Island, Illinois; Dr. Richard Needles, Chicago, Illinois; Dr. J. C. Neill, Philadelphia, Pennsylvania; Dr. J. Smith Nifong, Greensboro, North Carolina; Dr. J. S. Nupuf, Canton, Ohio; Dr. Don R. Paine, Topeka, Kansas; Dr. W. W. Parker, Lumberton, North Carolina; Dr. George A. Parkins, Ord, Nebraska; Dr. J. D. Perry, Jr., Winston-Salem, North Carolina; Dr. John T. Peterson, Rockford, Illinois; Dr. Harry E. Pine, Chicago, Illinois; Dr. D. F. Preble, Bath, Maine.

Dr. D. R. Reed, LaPorte, Indiana; Dr. G. C. Richter, Lawrenceburg, Indiana; Dr. W. H. Rozell, Chicago, Illinois; Dr. John R. Schaefer, Statesville, North Carolina; Dr. O. A. Schuessler, Cincinnati, Ohio; Dr. S. L. Shaw, Wheeling, West Virginia; Dr. J. G. Shelton, Austin, Texas; Dr. Carl F. Shepard, Chicago, Illinois; Sir Arthur Sherrington (O.M.), London, England; Dr. Robert J. Shreve, Indianapolis, Indiana; Dr. Harold Simmerman, Woodbury, New Jersey; Dr. F. W. Sinn, Philadelphia, Pennsylvania; Dr. D. D. Slater, Hot Springs, South Dakota; Dr. S. Winfield Smith, Wilmington, Delaware; Dr. G. F. Speiser, Mishawaka, Indiana; Dr. Donald A. Springer, Anniston, Alabama.

Dr. W. T. Stevesson, Chicago, Illinois; Dr. Eugene W. Strawn, Freeport, Illinois; Dr. Rudolph T. Textor, Cranford, New Jersey; Dr. David C. Thomson, Detroit, Michigan; Dr. George W. Ticknor, St. Joseph, Michigan; Dr. R. W. Tubesing, Richmond, Indiana; Dr. William O. Vivian, Media, Pennsylvania; Dr. Bernard E. Vodnoy, South Bend, Indiana; Dr. R. N. Walker, Winston-Salem, North Carolina; Dr. William G. Walton, Jr., Merion, Pennsylvania; Dr. G. H. Warkentine, Cedar Rapids, Iowa; Dr. Arthur P. Wheelock, Des Moines, Iowa; Dr. Ralph E. Wick, Rapid City, South Dakota; Dr. C. H. Wiesepape, Columbia, South Carolina; Dr. Ernest C. Wille, Jr., Denver, Colorado; Dr. Henry L. Wolfe, Marshalltown, Iowa; Dr. Daniel Woolf, New York, New York; Dr. J. Zettel, Jr., Cincinnati, Ohio.

Also present as guests of the Academy were the following students from Northern Illinois College of Optometry: N. F. Adelman, K. L. Blodgett, Charles Brown, Fern S. Block, Donald Cochran, I. Deitchman, Stanley P. Evans, Herbert Fischer, Ward B. Mackeen, W. E. Malinka, Jr., J. C. Manville, Albert H. Rodriguez, Harry Rothman, V. F. Schumaker, James Wright, James R. Warrick, Hubert P. Wechsler.

ANNUAL REPORT OF THE PRESIDENT

Harold M. Fisher

Fellows of the Academy: I am well aware that at this time I am expected to present to you a detailed report of my activities as your president. The seven-month period which constitutes my "year" of office has indeed encompassed the full range of activities of a normal Academy

year, though in point of time I must admit that this period scarcely seems more than a few weeks.

I feel no inclination to declaim on my own personal activities during this period. I have devoted many hours in trying to be of assistance to some of our committee chairmen and I have done, to the best of my ability, the routine tasks which came to me as president. It would not be proper for me to report in greater detail on these activities lest it be inferred that I attempt to detract from the very splendid work which has been done for you by the several Academy committee chairmen who have served the Academy so well this year.

As your newly-elected president one of my first acts was to re-read the constitution and by-laws of the Academy. This because I feel it is the duty of every newly elected officer to acquaint himself fully with the duties and responsibilities which he assumes in taking office. As president it seems to me particularly important that I be able to accurately interpret and execute the objectives of the Academy as expressed in its constitution and by-laws. I had thought in prior years that I was fairly well acquainted with the rules and regulations under which we operate, but re-reading these rules and regulations from the viewpoint of your president, I became acutely aware of what appeared to be certain shortcomings of our by-laws in two particulars: (1) Our membership requirements seemed to me to be somewhat ambiguous and difficult to interpret and enforce, not only insofar as the parent organization is concerned, but particularly on the chapter level. (2) The entire question of Academy chapters seems very inadequately covered in our present by-laws. After considerable study I have prepared some notes relative to changes in our by-laws which I hope will serve as a basis for clarification of these important points. These proposals have been presented to the Executive Council and the Council has authorized the appointment of a constitution and by-laws committee to study these and any other related questions and make recommendations to the Executive Council which can then be submitted to the vote of the membership as required by the present constitution and by-laws.

During my term the Academy has appropriated grants-in-aid in the amount of $2,000 for research in visual problems. This will be reported to you in greater detail by the chairman of our Research Projects committee.

Two new committees were authorized during this past year, one to study the advisability of establishing an optometric library-museum under Academy sponsorship, the other to study the question of evaluat-

ing new instruments and techniques as they are presented to the profession. These committees have studied the problems assigned them and are making recommendations to the Executive Council which will result in establishing policy on these matters.

The founders of the American Academy of Optometry, some 26 years ago, were quite explicit in their statement of the aims and objectives of the Academy which are to initiate and support research, encourage scientific observation and afford an opportunity to present and discuss the results of research on visual problems. It was also clearly stated that the Academy should represent and enforce the highest standards of ethical practice. During the years of its growth the Academy has undoubtedly set the pace in matters concerned with ethical practice. This was a problem which the profession of optometry through its regularly constituted organizations was in no way prepared to adequately face. While we cannot alone claim credit for the improvement in the ethical standards of optometrists who are not members of the Academy, I cannot help but feel that our unequivocal stand in enforcing adherence to a rigid code of ethics has helped to bring about the trend toward professionalism which is now everywhere manifest. It is my opinion that organized optometry is fast approaching the time when the standards of professional practice which they define and enforce will meet our own jealously guarded standards. As that happy day approaches I feel that the Academy should turn its efforts evermore toward the support and encouragement of research. During the past few years the Academy has contributed materially to the support of research. It is my earnest hope that in the years to come there will be an ever greater and greater development of this phase of our activity, for only when we exercise to the full our capacity to support and encourage research will the American Academy of Optometry come into its own as guardian of the public welfare in matters relating to vision.

ANNUAL REPORT OF THE SECRETARY-TREASURER

Carel C. Koch

This secretary-treasurer's report covers the period May 1 through November 30, 1947, the time which has elapsed since our Philadelphia meeting. As usual, I can report progress to the membership.

During these seven months a successful, though postponed, 1946 annual meeting was held in Philadelphia.

A new president, Dr. Harold M. Fisher of New York, was elected and installed in office.

A new Executive Council was elected and like its predecessor is proving an effective administrative unit for the Academy.

New committees were appointed and have been active in the work assigned to them.

Two new chapters received approval and charters will be presented to them at this session. These are the North Carolina and Illinois chapters.

The examining board, following instructions of the Executive Council, organized five sub-examining committees at the chapter level. These are geographically distributed to permit applicants to take the Academy examinations without having to travel great distances. During this same period the examining board screened approximately 80 applications and is now conducting both written and clinical examinations on the campus of the Northern Illinois College of Optometry here in Chicago.

During this seven-month period, 25 applicants have been approved by the examining board and the Executive Council. These optometrists, scientists and educators are now members of the Academy. We welcome them at this, their first annual meeting of the Academy.

A number of our chapters have held outstanding educational sessions during the period covered by this report and from all chapters have come forward-looking forecasts for 1948.

As secretary I am pleased to report no losses by death since my last report to the Academy, and only two resignations.

During this period we of the Academy have, through the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY, published a great number of original papers dealing with ocular refraction and technical matters of interest to optometrists. As this publication is widely read from coast-to-coast as well as in Canada and abroad, the scientific material brought together through Academy influences is given a wide audience. Our readership is now nearing the 6,000 mark.

(The secretary then presented the financial statement of the Academy as approved by the auditing committee. This statement was mailed to all members.)

NEW MEMBERS OF THE ACADEMY

The following optometrists, educators and scientists were elected to Fellowship in the American Academy of Optometry during the quarter

ending December 31, 1947. The Executive Council welcomes these new members.

Dr. Alexander E. Allen, 210 Haberfelde Building, Bakersfield, California.

Dr. S. Howard Bartley, Psychology Department, Michigan State College, Lansing, Michigan.

Dr. Melvin B. Dunbar, 57 North Park Street, Lebanon, New Hampshire.

Dr. Sidney S. Haniford, 289 West Ferry Street, Buffalo, New York.

Dr. L. D. Huber, 206 State Street, St. Joseph, Michigan.

Commander F. P. Mooney, H(s) USNR. Naval Receiving Station Dispensary, Navy 128, F.P.O., San Francisco, California.

Dr. J. D. Perry, Jr., 304 O'Hanlon Building, Winston-Salem, North Carolina.

Dr. Donald F. Preble, Bath, Maine.

Commander R. Roswell Sullivan, H(s) USNR. U. S. Naval Dispensary, Navy Building, Washington, District of Columbia.

Dr. Frederick A. Woll, 679 East 224th Street, New York, New York.

LOCAL CHAPTER ACTIVITIES

SOUTHERN CALIFORNIA CHAPTER

Use of red free light for determination of incipient cyst formation, and employment of the indirect ophthalmoscope instead of the direct was advocated to Southern California chapter members by Dr. Grant Balding, diplomate of the American Board of Ophthalmology. Dr. Balding was guest speaker at the November meeting of the chapter.

The direct ophthalmoscope affords an easier and better view of the foveal area and peripheral fundus than the direct method, according to Dr. Balding.

He also pointed out in his discussion of diagnostic aids in eye examination that the "golden glow" seen in cataract cases is significant of the presence of cholesterin.

PUBLISHER'S NOTICE—Notice of change of address of your American Journal of Optometry and Archives of American Academy of Optometry should be received in the office of the American Journal of Optometry Publishing Association by the first of the month to affect the following month's issue. Be sure to include your postal zone number.

CURRENT COMMENTS

Virginia Huck
Editorial Assistant

Optometrists will confer a favor by sending news items of general interest for this department; such as relate to new instruments, clinical techniques, education, visual health and optometric legislation and organization.

ACADEMY MEMBERS TO QUALIFY AS CONTACT LENS SPECIALISTS

The subject of specialization in optometry was the center of a great deal of discussion during 1947, and just before the ringing out of the old year, talk about specialization was turned into constructive action. At the annual meeting of the American Academy of Optometry in Chicago, December 13-16, the contact lens section under the direction of Dr. John C. Neill, Philadelphia, recommended establishment of an examining board to determine who in the Academy is qualified to become a contact lens specialist. The Executive Council unanimously voted to establish this board.

Under the new set-up, as explained in detail under "Transactions of the Academy" in this issue, Academy members who pass qualifications drawn up by this appointed examining board will be awarded diplomas certifying their ability to fit contact lenses. The examining board will be composed of faculty members of our optometric schools who teach contact lens fitting.

Through this step, requirements for Academy members to become contact lens diplomates now parallel requirements for contact lens specialists in Great Britain, and in the Journal's opinion, the way is paved for similar action by other sections not only in the contact lens field but other specialized fields as well. As stated before in "Current Comments" certifying of specialists is unquestionably beneficial to both the profession and the public. We hope 1948 will show further progress in this direction.

LEADERS FOR FOUNDATION DRIVE APPOINTED

Appointment of optometrists to direct membership drives for the American Optometric Foundation is nearing completion, according to Dr. William C. Ezell, president. Dr. Ezell's latest report indicates that appointments have been made in more than two-thirds of the states, as follows:

Dr. Thomas D. Hopkins, Montgomery, Ala.; Dr. D. D. Northrup, Phoenix, Ariz.; Dr. Charles H. Brown, Little Rock, Ark.; Dr. William W. Anderson, San Francisco, Calif.; Dr. Richard Lee Haney, Denver, Colo.; Dr. Lester H. Sugarman, Meriden, Conn.; Dr. M. Burton Meyer, Wilmington, Del.; Dr. Evart Warren, Washington, D. C.; Dr. Walter C. Kennedy, Sarasota, Fla.; Dr. Walter R. Wilson, Jr., Douglas, Ga.; Dr. Richard H. Wilson, Boise, Idaho; Dr. Glenn H. Moore, Chicago, Ill.; Dr. Harold

Cline, Elkhart, Ind.; Dr. Lynn C. Holman, Cedar Falls, Iowa; Dr. Sam T. Roberts, Jr., DeRidder, La.; Dr. Bradford F. Burgess, Rockland, Maine; Dr. G. William Seabold, Baltimore, Md.; Dr. Lincoln A. Palmer, Boston, Mass.; Dr. D. O. Emmons, Cadillac, Mich.; Dr. Harold L. Carlson, Mankato, Minn.; Dr. Prospero DeMarco, Natchez, Miss.; Dr. John N. Betz, St. Louis, Mo.; Dr. M. D. Crossett, Wahoo, Nebr.; Dr. Earl Pratt, Reno, Nev.; Dr. John J. Brown, Perth Amboy, N. J.; Dr. Zene Spence, Goldsboro, N. C.; Dr. Harold W. Oyster, Marietta, Ohio; Dr. Elmer M. Soles, McKeesport, Pa.; Dr. J. Nathan Lipscomb, Gakney, S. C.; Dr. J. D. McMillan, Brookings, S. D.; Dr. W. D. Sullins, Athens, Tenn.; Dr. Weston A. Pettey, Lubbock, Texas; Dr. M. F. Burgess, Cedar City, Utah; Dr. Frederick L. Wyman, Rutland, Vt.; Dr. William Greenspon, Bluefield, W. Va.

All remaining states are in the process of making similar appointments, Dr. Ezell said. As outlined in a recent issue of the Journal, the Foundation has been organized to raise money to advance optometric education and research, and for the benefit of optometry as a whole.

OPTOMETRY SCHOOL TO EXPAND FREE CLINIC FACILITIES

Pennsylvania State College of Optometry's free public eye clinic in Philadelphia will be expanded to accommodate approximately 25 per cent more patients, school officials report. The greatest expansion will be in the visual training department where four new instruments will be added to take care of the growing visual needs of the public school children, according to Dr. Albert Fitch, president.

"We have found it necessary to expand our facilities because the public needs such services badly," Dr. Fitch said, "especially the younger generation currently attending the public schools."

Cost of the equipment will be $30,000. Scheduled for installation are five chairs and units, five stools, five phoroptors, five project-o-charts with arms for units, five ophthalmometers, three chairs, five phorometers, six stools, one ophthalmograph, one synoptophore, two stereo-orthopters, one tachistoscope, five instrument tables, two floor stands, one stereo-disparator, one troposcope, one rotoscope, two sight screeners and two orthoraters.

SUGGESTIONS FOR BRITISH GIFTS

"Rice, cooking fats, sugar, and tinned meats," was British optometrist Lord Charnwood's answer to queries from Academy members during the Chicago annual meeting on what to send to friends in England. Lord Charnwood was a guest of the Academy at the convention.

'We haven't seen rice in years," Lord Charnwood said, adding that reports of starvation in England are untrue. "No one is starving—food rations just do not provide top energy for the average working man," he explained.

BETTER VISION INSTITUTE MERITS CONTINUED SUPPORT

The Journal's own opinions about optometry's 1948 future are

mirrored perfectly by those expressed in a letter from the Better Vision Institute to its members. "The outlook looks favorable for such a basic service as professional eye care," officials of this organization predict.

In the not too distant future, eyes will be taken care of on the same frequent systematic basis as teeth if the present trend continues and educational effort is continued, they point out.

The Journal, too, believes 1948 will be a good year for optometrists, and urges that professional men support the Better Vision Institute to help make it one. For 17 years this organization has directed its efforts toward professionalism and helping keep America eye conscious, and its past successes warrant the optometrist's continued backing.

PENN STATE DROPS ACCELERATED CURRICULUM

The freshman class of 140 students which enrolled at Pennsylvania State College of Optometry on December 1 will be the last accepted on an accelerated curriculum basis, Dr. Albert Fitch, president, announced recently.

Entrance schedules will return to prewar normal with the freshman class of September, 1948, he explained.

The new class, which is the 33rd to enter the college since it was chartered in 1919, will attend classes 18 months before receiving a vacation. More than 75 per cent of the new students are veterans, Dr. Fitch reported.

According to a Journal survey in July, 1947, the majority of our optometric schools will be on a prewar entrance schedule by September of this year.

BOOK NOTICES

DRAWING BY SEEING. Hoyt L. Sherman, Professor of Fine Arts. The Ohio State University, with the collaboration of Ross L. Mooney and Glenn A. Fry. Published by Hinds, Hayden & Eldredge, 105 Fifth Avenue, New York 3, New York. 77 pages. Illustrated. Cloth. 1947.

Adelbert Ames, Jr., sometime prior to World War I started original studies dealing with the principles of visual form as related to the art of painting pictures. His research ultimately lead to the formation of the Dartmouth Eye Institute and its investigations on aniseikonia. Later on, attacking this problem from an entirely different angle, Samuel Renshaw at the Ohio State University did some outstanding work in the

field of peripheral stimulation and visual perception for the United States Navy.

Sherman and his collaborators, Mooney and Fry, using results from both researches and adding much from their own experiences in both the art and visual science fields have developed a new technique of teaching art students how to see.

At the request of the reviewer, Clarence R. Chaney,[1] a Minneapolis banker with a successful avocational background as an artist, read this new text. Mr. Chaney's comments follow:

"The book, 'Drawing by Seeing,' which I am returning is most interesting. Mr. Sherman's unique plan is based on two theories which I have long been conscious of and have demonstrated many times to my own satisfaction: first, that drawing is largely seeing, and second, that seeing too much may spoil any picture. I have found, and many of my friends who work at this thing either professionally or as a hobby, have said to me that with proper concentration and careful view of the subject, the picture to a considerable extent draws itself.

"Because of this, I usually select my subject long in advance of making my drawing and look at it casually from time to time before starting. When I am ready to make my drawing, I like to view it for eight or ten minutes before putting a line on the paper, trying to see only the size, shape and relative positions of the principal masses. If it works well, I find that I do not have to consciously determine the direction or length of any line, and the drawing does, to a great extent, put itself on the paper or canvas. On the other hand, I have learned never to finish a drawing on the spot. Regardless of how well disciplined a man is, details of the subject are bound to intrude if he stays with it long enough. If this happens early in the work, it is bound to interfere with the proper recording of the principal masses in the picture and even at a later stage, such details will clutter up the drawing and rob it of its best effect. People who do not make pictures rarely realize the fact that simplicity of treatment is the main virtue of most pieces of work.

"Mr. Sherman's method should accomplish both of these things, and while there are many phases of it that can only be well understood by actual experience, it strikes me as an excellent way to start new students off on the right foot.

"In accepting these comments, please remember they come from an amateur and are offered with my apologies for having been so long in returning the book to you."

[1] Vice Chairman of the Board, Northwestern National Bank of Minneapolis.

As indicated, the new work by these authors deals with the subject of employing the entire visual field or as much as possible of it, in the act of seeing. They outline their experimental work and their new teaching procedures in detail. Aside from its value to the student of art, the book is also of value to optometrists as it evaluates again the benefits to be gained by training the peripheral fields to function more effectively.

CAREL C. KOCH

ABSTRACTS

A department in which will appear abstracts of the literature of optometry, ophthalmology and applied optics. These will be classified according to the following list although contributions to all sections will not necessarily appear in each issue.

1. Ocular Refraction.
2. Physiological Optics and Color Vision.
3. Ocular Muscles.
4. Orthoptics and Reading.
5. Anatomy, Histology and Embryology.
6. Ocular and General Pathology.
7. Ophthalmic Lenses and Material.
8. Instruments.
9. Hygiene and Illumination.
10. Applied and Physical Optics.
11. Education, Sociology and Economics.
12. Miscellaneous.

1. Ocular Refraction

PRISMS IN ANISOMETROPIA. L. A. Swann. The Optician. (London). 1944. 108., 2795., 181-183.

In England, Swann claims, many adult anisometropic patients, irrespective of their muscle balance, use their glasses only for intensive vision and go uncorrected the remainder of the time. He has observed that in these cases the visual acuity of the poorer eye does not change materially and that these patients seem comfortable with this state of affairs. Naturally, when uncorrected, they are doing most of their "seeing" monocularly, and the author points out that much of our literature indicates that under these conditions vision should deteriorate. This he fails to find.

He presents a series of case reports which indicate the failure to prescribe needed prisms in certain of these anisometropic cases may account for the patients unwillingness to use their corrections more constantly.

C. C. K.

PSYCHOLOGY IN THE CONSULTING ROOM. L. J. Giles. South African Optometrist. (Johannesburg, South Africa.) 1945. August-October issue. 64-65.

The author suggests that nervous patients, and many are, should be helped to relax by being led into a discussion of some general subject

before the examination is started. He also claims that it makes the findings more satisfactory if one builds confidence on the part of the patient by a careful prior explanation of what is wanted of him during the subjective portion of the test. Another of his practical suggestions is to have the patient read the chart of test types from the large characters at the top down, rather than start with the 20/20 line, or if this takes too much time start with the 20/50 line or some line you are sure the patient can read. He points out that when a patient achieves some act successfully, a great "flip" is given psychologically—we term it that their "spirit soars." On the other hand, if a patient is not able to do something he is asked to do, the opposite effect results.

The explanation of cataract to the older patient is another problem. Giles once heard a doctor telling a "poor old soul" that she was going blind. He thinks this is both bad and unkind psychology. He suggests that the optometrist explain cataract in the following manner as it will worry the patient much less: "The eye consists of approximately three-quarters water. If you leave a glass of water for a long time, it becomes misty. You are not as young as you were and the eyes are not as clear as they were." A. V. H.

SIMPLIFYING FIELD OF VISION TESTS. L. A. Swann. The Optician. (London.) 1945, 108, 2807, 385-386.

The author finds that testing the fields of vision is frequently omitted from routine refractive tests because of the time consumed in taking these. He feels the use of the Bjerrum screen sufficiently simplifies the technique as to warrant at least a brief field test in every refraction. This paper describes the screen and the technique of its use and reviews some of the diagnostic data the optometrist may get from taking the fields of vision. C. C. K.

JUVENILE DELINQUENCY AS AN OPTOMETRIC PROBLEM. C. Brooks. The Journal of the American Optometric Association, 1947, 18, 6, 307-311.

Tele-binocular tests were made on a group of 58 children with poor social backgrounds and histories of delinquency. Similar tests were made on an average group of junior high school children of similar ages. A comparison of the results is presented by the author indicating lower average scores by the delinquent group. A. V. H.

PRACTICAL DIAGNOSIS OF HEADACHE. H. W. Reinitz. North Carolina Optometrist. 1945, 10, 1, 1.

The author points out that aside from manifest presbyopia, the common headache is one of the chief factors causing people to seek the services of an optometrist. Reinitz then classifies headaches as mechanical, toxic and functional, and presents a brief outline of each. Most ocular headaches, he claims, are found to be mechanical. T. O. B.

AN EXAMPLE OF INCREASED PRODUCTION THROUGH AN INDUSTRIAL VISION PROGRAM. N. C. Kephart. The Optical Journal and Review of Optometry. 1946, 93, 18, 3-34.

This paper deals wtih the near-point visual skills required of the worker in industry whose occupation requires a visual concentration at the working level. A survey was made of such a group and to those workers who failed to pass the tests recommendations were made for professional visual care. A year later the same tests were repeated. In the group who had failed to pass the tests a comparison was then made as to their production and earnings after proper visual care. Both figures were found to be improved, the earning increase for the individuals in the group averaging about $4 for each 40-hour week. T. O. B.

OBJECTIVE OBSERVATIONS AND SUBJECTIVE FINDINGS WITH TANGENT CONE LENSES. C. J. Hellinger. The Optical Journal and Review of Optometry. 1947, 84, 3, 29-31.

This paper describes Tangent Cone contact lenses and presents in chart form the instructions to be followed in fitting these aids to subnormal vision. A. V. H.

INDUSTRIAL VISUAL SCREENING CASE REPORT. F. W. Staubach. Optometric Weekly. 1946, 37, 11, 339-342.

Normal binocular vision has an important part to play in efficient production in industry. The author reviews a plant survey in which the employees were given visual screening tests by means of the AO sight-screener to explore the relationship between visual skills and job efficiency. A. V. H.

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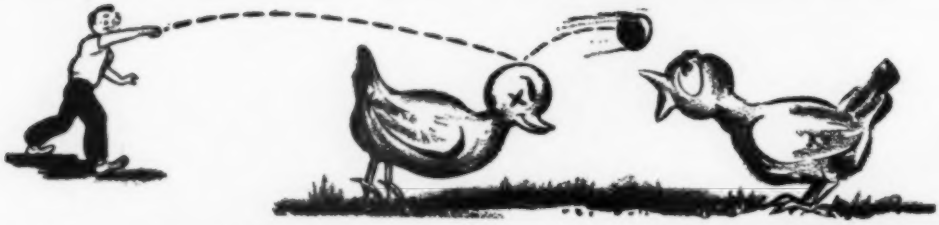

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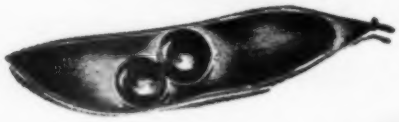

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